

CAMDEN COUNTY, NEW JERSEY
SPECIFICATIONS AND CONTRACT DOCUMENTS
FOR THE CONSTRUCTION OF
CHALLENGE GROVE PARK PAVILION IMPROVEMENTS
BID NO. A37-20

JUNE 2020

CAMDEN COUNTY BOARD OF CHOSEN FREEHOLDERS

PREPARED BY:



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Professional Engineer
New Jersey License No. 34458

Our File No.:CCM00208.01



CONSULTING AND MUNICIPAL ENGINEERS

3141 BORDENTOWN AVENUE, PARLIN, NEW JERSEY 08859 — 1460 ROUTE 9 SOUTH, HOWELL, NEW JERSEY 07731-1194
ONE MARKET STREET, SUITE 1F, CAMDEN, NEW JERSEY 08102

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SPECIFICATIONS

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**INVITATION TO BID
FOR BID #A37-20
CHALLENGE GROVE PARK
PAVILION IMPROVEMENTS**

Notice is hereby given that sealed bids for **Bid #A37-20**, Challenge Grove Park Pavilion Improvements will be received, opened and read in public at the Camden County Courthouse, **1st Floor Lobby**, 520 Market Street, Camden, New Jersey 08102 on **Thursday August 13, 2020 at 11:00AM** prevailing time by the Camden County Purchasing Agent or her designee.

It is recommended that each bid be sent by U.S. Mail to the Camden County Division of Purchasing, Courthouse 17th Floor, 520 Market Street, Camden, NJ 08102. If hand-delivered, bids must be left in the bin accessible from the 6th Street entrance of the Courthouse at 520 Market Street, Camden, NJ 08102. Bin access is 8:30 AM to 4:00 PM only. The County assumes no responsibility for delays in any form of carrier, mail or delivery service causing the bid to be received at the **Division of Purchasing** later than the above-referenced scheduled opening.

Paper copies of the bid documents may be obtained at the office of **CME Associates, 1 Market Street, Suite 1F, Camden, NJ 08102** (telephone 732-410-2651). Bidder may also contact the office to arrange for mailing of documents.

All bidders are strongly encouraged to attend a pre-bid meeting to be held at Challenge Grove Park, 101 Bortons Mill Road, Cherry Hill, NJ 08034, on **Wednesday, July 22, 2020 at 10:00 AM**, prevailing time, to fully understand the specifications and conditions of work to be done under this bid. A tour of the location will take place after the pre-bid.

All Requests for Information (RFI) must be submitted by email to Jim Winckowski, at JWinckowski@cmeusa1.com by Wednesday, July 29, 2020 at 12:00PM.

Bidders are required to comply with the requirements of P.L. 1975, c.127 (N.J.A.C. 17:27).

Bidders are required to comply with the requirements of P.L. 1999, c. 238 (N.J.S.A. 34:11-56.48 to 57), where applicable.

All bidders are responsible for obtaining complete bid documentation from the County at the website listed above. In the event of any inconsistencies between this advertisement, as published, and the bid documentation, the bid documentation shall control.

By order of the Board of Chosen Freeholders of Camden County, New Jersey.

Anna Marie Wright,
Camden County Purchasing Agent

**CAMDEN COUNTY DIVISION OF PURCHASING
COURTHOUSE - 17TH FLOOR
520 MARKET STREET
CAMDEN, NEW JERSEY 08102-1375
(856) 225-5439**

DATE **JULY 10, 2020**

Bid No. and Title: **CHALLENGE GROVE PARK PAVILION IMPROVEMENTS**

BID NO. A37-20

BIDS MUST BE RETURNED NO LATER THAN **11:00AM** O'CLOCK, PREVAILING
TIME ON **AUGUST 13**, 2020.

1. PRICES MUST INCLUDE DELIVERIES TO ALL SITES SET FORTH HEREIN.
2. Quotations must be made on these sheets. Camden County is not responsible for any expenses incurred by any firm in preparing or submitting a bid proposal.
3. Prices may be submitted on any or all the items listed unless otherwise specified. Award of contract for goods and services will be made based on the lowest responsible bid on each item or on an aggregate basis, whichever is in the best interest of Camden County and System Members (if this is a Cooperative Pricing bid).
4. Insert NET UNIT PRICES. Bids must be firm for a minimum of 60 days. Contract prices may not be increased during the term of the contract.
5. Camden County and System Members are exempt from sales tax.
6. The County of Camden reserves the right to accept or reject any part or parts of the responses to this bid in accordance with law.
7. To the extent that any of these instructions directly contradict the bid specifications, the bid specifications shall prevail.
8. The County of Camden shall only be responsible for the payment of interest or late fees as provided pursuant to N.J.S.A. 2A:30A-2(c).
9. Official County bid packages for routine goods and services are available from the Camden County Division of Purchasing at no cost to the vendor. (Bids for highway projects are issued by that department for a fee). All addenda are issued by the Division of Purchasing (or Highway department if applicable). **Potential bidders are cautioned that they are bidding at their own risk if a third party supplied the bid specifications.** Such specifications may or may not be complete. The County is not responsible for third party supplied bid specifications.
10. Bidders are required to comply with the requirements of P.L. 1999, c. 238 (N.J.S.A. 34:11-56.25 et seq.) regarding prevailing wages, where applicable.

11. Bidders are hereby noticed that the County shall correct certain types of clerical errors if found in submitted bids. For example, if the quantity needed or the standard unit of measurement used, times the unit price, is incorrectly calculated in reaching a total or final price, the County will correct the computational mistake.
12. The county requires bidders to list any exceptions to the bid specifications. For any exceptions listed the County shall determine if it will accept an immaterial, or minor, deviation from its bid specifications as permitted by law. Material exceptions shall be cause for rejection of the bid. Bidders shall not be permitted to remove listed exceptions.
13. N.J.S.A. 40A:11-2.1 and 52:32-55 prohibits State and local public contracts with persons or entities engaging in certain investment activities in energy or finance sectors of Iran.
14. Official notification of contract awards authorized by the County may be viewed on camdencounty.com. To review, click on the gold "Your Government" tab, scroll to the information box on the left and click on "County Public Information", then click on "Freeholder Meetings". Meetings and agendas are found here. Click on "Freeholder Meeting (AGENDA)" for the month you would like to view. Copies of resolutions and bid results require an OPRA request. See camdencounty.com for OPRA form and process.
15. Should any requirements or language contained in the contract documents/technical specifications be found to conflict with the County's general bid boilerplate (ITB pages), the requirements/language in the bid boilerplate shall prevail.
16. BIDDERS ARE REQUIRED TO USE THE COUNTY'S FORMS AND SHALL NOT RECREATE IN ANY WAY THE FORMS PROVIDED WITH THIS BID. FAILURE TO USE THE COUNTY FORMS OR ADDING TO, AMENDING, ALTERING, OR REVISING THE COUNTY FORMS, INCLUDING, BUT NOT LIMITED TO, CONVERTING THE COUNTY PDF OR HARDCOPY TO A WORD DOCUMENT, SHALL BE CAUSE FOR REJECTION OF THE BID.

WE SUBMIT HERewith our prices as indicated on the following bid.

Submitted on _____, 20____ BY _____
(Name of Company)

Fax No. _____ PER _____
(Signature and Title of
Authorized Representative)

E-Mail: _____ Phone No. _____

BIDDER'S CHECKLIST

THIS BIDDER'S CHECKLIST MUST BE COMPLETED, SIGNED AND SUBMITTED WITH YOUR BID PACKAGE.

1. Bid Guarantee deposit in the form of a certified check, cashier's check or bid bond. See Paragraph 4.1 and **Exhibit A**. (Must be submitted with bid) _____
2. Certificate from a Surety Company or Financial Institution stating that if bid is accepted, they will provide the required performance bond or Letter of Credit. See Paragraphs 4.2, 8.1 and 8.2, and **Exhibits B, C, and D**. (Must be submitted with bid, **must include originals – copies will not be accepted**) _____
3. Statement of Corporate Ownership listing the names and **HOME addresses** of all individuals owning ten percent (10%) or more of corporation, partnership or LLC. See **Exhibit E**. (Must be submitted prior to or with bid) _____
4. Non-collusion Affidavit properly notarized. See **Exhibit F**. _____
5. Affirmative Action Questionnaire with available evidence submitted. See Paragraph 5 and **Exhibit I**. _____
6. Affirmative Action MBE/WBE Tracking Form. See Paragraph 5 and **Exhibit J**. _____
7. Debarment Certification Form. See **Exhibit K**. _____
8. Extension or Non-Extension of Prices to Registered System Members (Other Agencies) See Paragraph 22.1 and **Exhibit L**. N/A
9. Textile/Apparel Subcontractor Disclosure Requirements

For Bids for Textiles and/or Items of Apparel Only.
Disclosure of all subcontractors and sites and Certification of Compliance for textile and apparel bids. See Paragraphs 23.1 and Paragraph 23.2 and **Exhibit M**. (Must be submitted with bid). N/A

[BIDDER'S CHECKLIST CONTINUED NEXT PAGE]

BIDDER'S CHECKLIST (cont'd)

- | | | |
|-----|---|---------------------|
| 10. | Proof of compliance with The Public Works Contractor Registration Act, if applicable. See Paragraph 24.
(Must be submitted prior to award of contract). | _____ |
| 11. | <u>Construction Subcontractor Disclosure Requirements</u>

a. For Bids for Construction Only.
Disclosure of subcontractors as required by <u>N.J.S.A. 40A:11-16</u> . See Paragraph 26 and Exhibit N .
(Must be submitted with bid) | _____ |
| 12. | Proof of compliance with the requirements for significant public works projects, where applicable. See Paragraph 27 and Exhibit O .
(Must be submitted with bid). | _____ |
| 13. | Proof of compliance with the State Contractor Business Registration Program. See Paragraph 31. | _____ |
| 14. | Acknowledgement of Receipt of Addenda, whether or not issued, <u>N.J.S.A. 40A:11-23.2</u> . See Paragraph 32 and Exhibit Q . (Form must be submitted with bid). | _____ |
| 15. | Uniformed Law Enforcement Officer requirement form.
Exhibit R. | N/A
_____ |
| 16. | Certification - Disclosure of Investment Activities in Iran, Exhibit S . (Form must be submitted with bid). | _____ |

NAME OF BIDDER

SIGNATURE

DATE

INSTRUCTIONS TO BIDDERS

1. RECEIPT, OPENING, WITHDRAWAL OF BIDS, AND FAILURE TO RESPOND

- 1.1 Sealed Bids will be received by the County on the date, time, location, and in the manner as listed in the advertisement.
- 1.2 Bids must be received at the Camden County department stipulated in the advertisement no later than the due date and time indicated therein. It is recommended that bids be hand delivered to that department. The County assumes no responsibility for delays in any form of courier or mail order delivery service causing the bid to be received at the **department stipulated** later than the due date and time. All late bids will be rejected in accordance with the law.
- 1.3 Any bid may be withdrawn prior to the time for openings of bids or the authorized postponement thereof. Any bid received after the opening of bids will not be considered. No bidder may withdraw a bid within sixty (60) days after the actual opening thereof.

2. QUALIFICATION OF BIDDERS

- 2.1 The County may make such investigation as it deems necessary to determine the ability of the bidder to perform the work and the bidder shall furnish to the County all such information and data for this purpose as the County may request. The County reserves the right to reject any bids if the evidence submitted by, or investigation of such bidder, fails to satisfy the County that such bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated herein.

3. PREPARATION OF BID

- 3.1 **Bids must be submitted on the prescribed form. ONE ORIGINAL (1) AND TWO (2) COPIES** of the bid should be submitted. The bidder shall fill in all blank spaces in ink or by typewriter, both in words and figures. Bids must be signed in ink by authorities with capacity to legally bind the bidder to its bid proposal.
- 3.2 Each bid shall be based upon the specifications prepared by the County. The bidder accepts the obligation to become familiar with the County's specifications.
- 3.3 Each bid must give the full business address of the bidder and be signed by an authorized representative. Bids by partnerships must furnish the full name of all partners and must be signed in the partnership name by one of the members of the partnership or by an authorized representative, followed by the signature and designation of the person signing. Bids by corporations must be signed in the legal name of the corporation, followed by the name of the State of Incorporation and must contain the signature and designation of the President, Secretary or other person authorized to bind the corporation in the matter. When requested by the County, satisfactory evidence of the authority of the officer signing on behalf of the corporation shall be furnished.
- 3.4 Bids containing any conditions, omissions, unexplained erasures or alterations, items not called for in the proposal form, attachment or additive information not required by the bid documents, or irregularities of any kind, may be rejected by the County. Any changes, white-outs, strike-outs, etc. on the proposal page must be clear as to meaning and initialed by the person responsible for signing the bid.

- 3.5** The County reserves the right to waive any minor informalities in the bids received as permitted by law or reject bids under certain circumstances as permitted by law.
- 3.6** All bids must be submitted in sealed envelopes bearing on the outside the name of the bidder, address and subject and title of the specifications. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope, addressed as set forth in the advertisement. The County assumes no responsibility for mailings not received on time at the department stipulated in the advertisement to receive bids. It is therefore recommended that bids be hand delivered.
- 3.7** Bidders must insert prices for furnishing all the materials and/or labor required by these specifications whether or not such requirement is specifically set forth. Prices shall be net, including any charges for packing, crating, containers, etc. and all transportation charges fully pre-paid by the contractor F.O.B. destination and placement at locations specified by the County. No additional charges will be allowed for any transportation costs resulting from partial shipments made at the contractor's convenience when single shipment is ordered.
- 3.8** Payments will be made upon the approval of vouchers submitted by the successful bidder in accordance with the requirements of the Board of Chosen Freeholders and subject to the County's customary billing procedures.
- 3.9** The County reserves the right to grant up to three (3) business days' additional time to bidders after the bid opening to provide the following documents required by the bid specifications:
- a. Non-collusion affidavit. See **Exhibit F**;
 - b. Affirmative Action Questionnaire with available evidence submitted. See Paragraph 5 and **Exhibit I**;
 - c. Affirmative Action Plan MBE/WBE Tracking Form. See Paragraph 5 and **Exhibit J**;
 - d. Debarment Certification Form (Certification regarding the Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions). See **Exhibit K**.

Such additional time may not in any way affect the price or cost of the bid. All other documents required by the bid specifications must be submitted at the time of the bid opening specified herein or in accordance with law.

4. BID BOND/CONSENT OF SURETY OR LETTER OF CREDIT

4.1 BID BOND

Each bid must be accompanied by the Certified Check of the bidder or by a Cashier's Check, or by a Bid Bond prepared on the form of bid bond attached hereto as Exhibit A, duly executed by the bidder as principal, having surety thereon, a surety company approved by the County, in an amount not less than ten percent (10%) of the amount of the base bid submitted, said 10% not to exceed \$20,000.00 pursuant to N.J.S.A. 40A:11-21, payable to the Treasurer, Camden County. Only originals submitted on the County's form Exhibit A will be accepted.

4.2 CONSENT OF SURETY OR LETTER OF CREDIT

In addition, the bid must also be accompanied by a Certificate (Consent of Surety) from a Surety Company stating that it will provide said bidder with a Performance Bond in the full amount of the bid. County forms are required to be used. A form of Consent of Surety is attached hereto as **Exhibit B**. Only originals submitted on the County's form Exhibit B will be accepted. A form of Performance Bond is attached hereto as **Exhibit C**. **Exhibit C must be signed by the successful bidder and bidder's surety after award of contract and must be returned with the contract.** As an alternative to the consent of surety, bidders may provide a letter from a bank or similar financial institution stating that it will issue a Letter of Credit in the full amount of the bid and pursuant to the terms of the Letter of Credit in the specifications (See **Exhibit D**). **This Letter of Credit option is not available on bids exceeding \$100,000. Such bids require a Consent of Surety/Performance Bond. See N.J.S.A. 40A:11-22.**

- 4.3 Per N.J.S.A. 40A:11-24(a), All bid security, except the security of the three apparent lowest responsible bidders, shall be returned, unless otherwise requested by the bidder, within ten (10) days after the opening of bids, **Sundays and holidays excepted**, and the bids of such bidders shall be considered as withdrawn. Within three (3) days, **Sundays and holidays excepted**, after the awarding and signing of the contract, and the approval of the contractor's performance bond, the bid security of the remaining unsuccessful bidders shall be returned to them.

5. AFFIRMATIVE ACTION

- 5.1 The successful bidder shall adhere to the mandatory affirmative action language required by P.L. 1975, c.127 (N.J.A.C. 17:27) and N.J.S.A. 10:5-31 et seq.
- 5.2 For procurement, professional and service contracts, the above-referenced mandatory language shall be that set forth in **Exhibit G**.
- 5.3 For construction contracts, the above-referenced mandatory language shall be that set forth in **Exhibit H**.
- 5.4 All bidders should complete the Affirmative Action Questionnaire set forth in **Exhibit I** and follow its instructions.
- 5.5 All bidders should complete the Affirmative Action Plan MBE/WBE Tracking Form in **Exhibit J**.

6. ADDENDA AND INTERPRETATIONS

- 6.1 No interpretation of the meaning of any bid document will be made to any bidder orally. Any request for interpretation shall be in writing, addressed to the County's representative stipulated in the bid and must be received at least ten (10) days prior to the date fixed for the opening of bids. All such interpretations and any supplemental instructions will be in the form of written addenda to the specifications and will be distributed to all prospective bidders in accordance with N.J.S.A. 40A:11-23. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under his bid as submitted. All addenda so issued shall become part of the contract documents.

7. MISCELLANEOUS

- 7.1** At the time of the opening of bids, each bidder will be presumed to have read and to be thoroughly familiar with the specifications and all other bid documents (including addenda). The failure or omission of any bidder to receive or examine any form, instrument or document shall in no way relieve any bidder from any obligation in respect to his bid.
- 7.2** In case of default by the successful bidder, the County of Camden may procure the articles or services from other sources and hold the successful bidder responsible for any excess cost occasioned thereby.
- 7.3** County of Camden is exempt from any State sales tax and Federal excise tax. In submitting this bid, the bidder certifies that its total bid price does not include any such taxes.
- 7.4** For purposes of evaluation where an equivalent is being furnished, the bidder must indicate any variation to the County's specifications no matter how slight. If no variations are indicated, it will be construed that the bid fully and exactly complies with the County's specifications.
- 7.5** All bids submitted shall include in price any applicable permits, or fees required by any other government entity that has jurisdiction to require the same.
- 7.6** In submitting its bid, the bidder certifies that the merchandise to be furnished will not infringe upon any valid patent or trademark and that the successful bidder shall, at its own expense, defend all actions or suits charging such infringement, and will save the County harmless from any damages resulting from such infringement.
- 7.7** The bidder understands and agrees that, if awarded any contract by the County of Camden, it shall be responsible for insuring that it and all subcontractors meet minimum safety, health and equipment requirements including provisions for protecting employees and the public from any hazards encountered in performing its obligations pursuant to this bid.
- 7.8** All Firms are advised that, pursuant to N.J.S.A. 19:44A-20.27, it is their responsibility to file an annual disclosure statement with the New Jersey Election Law Enforcement Commission ("ELEC") if, during the calendar year, they receive a contract(s) in excess of \$50,000 from public entities, including Camden County. It is the firm's responsibility to determine if such filing is necessary. Additional information on this requirement is available from ELEC at 888-313-3532.

8. SECURITY FOR FAITHFUL PERFORMANCE

- 8.1** Simultaneously with its delivery of the executed contract, the successful bidder shall deliver to the County an executed bond in the amount of one hundred percent (100%) of the accepted bid as security for the faithful performance of this contract and for the payment of all persons performing labor or furnishing materials in connection therewith, prepared in the form of contract bond attached hereto and having a surety thereon such surety company or companies as are acceptable on bonds approved by the County, and as are authorized to transact business in this State.

- 8.2** In the event the successful bidder chooses to supply a Letter of Credit in lieu of the performance bond required by Section 8.1 above, said Letter of Credit shall be delivered to the County simultaneously with the delivery of the executed contract. The Letter of Credit shall be for the full amount of the bid and shall conform to the terms set forth in the terms of Letter of Credit in these specifications. **This Letter of Credit option is not available on construction projects exceeding \$100,000. Such projects require a Performance Bond. See N.J.S.A. 40A:11-22.**

9. INSURANCE REQUIREMENTS

(Where applicable the following insurance requirements shall apply).

9.1 Workers Compensation and Employer's Liability Insurance

This insurance shall be maintained in force during the life of the contract and shall cover all employees engaged in the performance of the contract. This insurance shall comply with all applicable statutes and regulations. Minimum Employer's Liability insurance of \$500,000.00.

9.2 General Liability Insurance

This insurance shall have limits of not less than \$1,000,000.00 per occurrence and \$3,000,000.00 aggregate for bodily injury and property damage and shall be maintained in force during the life of the contract.

9.3 Builders Risk Insurance

This insurance shall cover all building construction, reconstruction, alteration, or related work and shall have limits of not less than the agreed completed value of the project. The coverage shall be written on a replacement cost basis and a copy of such policy shall be provided to the County before construction commences. Coverage shall remain in force until a certificate of occupancy has been issued.

9.4 Automobile Liability Insurance

This insurance shall cover the Contractor for claims arising from owned, hired and non-owned vehicles and shall have limits of not less than \$1,000,000.00 per occurrence for bodily injury and property damage. Coverage shall be maintained in force during the life of the contract.

9.5 Insurance Requirements for Subcontractors

On any construction, reconstruction, alteration, or similar project, the Contractor shall require each Subcontractor to carry insurance coverage equal to or exceeding the type and level of coverage required to be carried by the Contractor. This coverage shall be in addition to the coverage carried by the Contractor.

9.6 Certificates of the Required Insurance

Certificates for the above listed insurance shall be submitted along with the signed contract as evidence that such insurance is in force and shall name the **County of Camden as additional insured**. The notice to proceed and/or purchase order will not

be issued by the County until the certificate of insurance is provided with the signed contract. Such coverage shall be with acceptable insurance companies operating on an admitted basis in the State of New Jersey.

9.7 Cancellation

Certificates for the above-listed insurance shall contain a provision that coverage afforded under the policies will not be cancelled without at least thirty (30) days prior written notice to the County of Camden.

10. INDEMNIFICATION

- 10.1** The contractor shall assume all risk of and responsibility for, and agrees to indemnify, defend, and save harmless the County of Camden and its officials and employees from and against any and all claims, demands, suits, actions, recoveries, judgments and costs and expenses in connection therewith on account of the loss of life, property or injury or damage to the person, body or property of any person or persons whatsoever, which shall arise from or result directly or indirectly from the work and/or materials supplied under this contract. This indemnification obligation is not limited by but is in addition to the insurance obligations contained in this agreement.

11. AWARD

- 11.1** Award of contract will be made by the Camden County Board of Chosen Freeholders within sixty (60) days after the bid opening or within the time allowed by law.
- 11.2** Upon award of the contract, appropriate documents shall be forwarded to the successful bidder. N.J.S.A. 40A:11-24(b) requires the contract to be signed by all parties within the time set forth in the specifications, which shall not exceed twenty-one (21) days, Sundays and holidays excepted, after the making of the award. At the expiration of such time, the County may elect to award the bid to the next lowest responsible bidder and accept as liquidated damages the bid security.

12. QUANTITIES

- 12.1** Quantities shown are approximate and the Board reserves the right to increase or decrease them to the extent of twenty percent (20%) at the unit price bid. If the number of units in the total is less than ten (10), the County shall have the right to increase or decrease the quantity to not more than ten (10) or less than one at same unit price. Such change, however, will only be upon the written order of the County.

13. PREVAILING WAGE ACT / CERTIFIED PAYROLL SUBMISSIONS

- 13.1** Pursuant to N.J.S.A. 34:11-56.25 et seq., P.L. 2009, c.249, and as amended, successful bidders on projects for public work shall adhere to all requirements of the New Jersey Prevailing Wage Act.
- 13.2** The contractor on any public works project for the County shall be required to submit a certified payroll record to the County Department administering said public works project. Such certified payroll record must be submitted within ten (10) days of the payment of the wages. The contractor is also responsible for obtaining and submitting all

subcontractors' certified payroll records within the aforementioned time period. The contractor shall submit said certified payrolls in the form set forth in N.J.A.C. 12:60 Appendix A. It will be the contractor's responsibility to obtain any additional copies of the certified payroll form to be submitted by contacting the Office of Administrative Law, CN 049, Trenton, New Jersey 08625 or the New Jersey Department of Labor, Division of Workplace Standards.

14. METHOD OF AWARD

- 14.1** For goods and services contracts the County may award the work based on the lowest responsible Base Bid or may elect to award the work based on the line items or unit prices, whichever is in the best interest of the County.
- 14.2** For construction contracts, the County will award the contract to the lowest responsible bidder whose base bid is the lowest.
- 14.3** If Alternates are provided for in the bid and the County determines it has sufficient funds to award some or all of the Alternates, the lowest responsible Base Bid combined with such Alternates as selected will be awarded until a net amount is reached which is within the funds available. Alternate(s) may also be deferred and awarded at a later date in the sole discretion of the County. **The cost of any Alternate(s) included in the bid shall not be combined with the Base Bid for purposes of determining the lowest responsible bidder for award of contract.**

15. TERM OF CONTRACT

- 15.1** The term of the contract to be awarded as the result of this bid shall be for one (1) year from the date of execution of the agreement unless otherwise stated.

16. TERMINATION

- 16.1** The County may terminate the agreement for any reason upon thirty (30) days written notice to the contractor. The County shall only be responsible for payment up to the effective date of termination.

17. AMERICAN GOODS AND PRODUCTS TO BE USED WHERE AVAILABLE

- 17.1** Pursuant to N.J.S.A. 40A:11-18, only manufactured and farm products of the United States wherever available, shall be used in the execution of the work or supply of goods as specified herein.

18. AVAILABILITY OF FUNDS

- 18.1** Pursuant to N.J.S.A. 40A:11-15 any contract resulting from this bid shall be subject to the availability and appropriation of sufficient funds annually.

19. PURCHASING FROM STATE CONTRACT

- 19.1** The County reserves the right to purchase, during the term of any contract to be awarded, any of the specified materials and/or services through the New Jersey State Cooperative Purchasing Agreement (State Contract) if it is in the County's best interest to do so.

20. BRAND NAMES AND/OR PRODUCT DESCRIPTION

- 20.1** Pursuant to N.J.S.A. 40A:11-13, brand names and/or descriptions used in this specification for bid proposal are to acquaint prospective bidders with the type of equipment (or commodity) described and will be used as a standard by which alternate or competitive materials offered will be judged. Competitive items must be equal to the standard described and be of the same reputation for quality and workmanship. Variations between the equipment described and material offered are to be fully explained by the bidder in an accompanying letter. In the absence of any changes by the bidder, it will be presumed and required that materials as described in these specifications be delivered.

It is recognized that no two pieces of equipment and no two products are engineered or designed the same. Trade names, brand names and models specified herein are provided to establish a minimum standard of quality acceptable to the County for this bid. Substitute brands, makes and models shall be considered and reviewed based on its ability to perform the specified tasks or provide the same quality of goods as specified in the County's bid. This is known as an "Equivalent".

If the bidder seeks to provide an Equivalent product or good, the bidder shall with its bid, submit specifications or cut sheets for such proposed Equivalent product or good.

The County's Architect/Engineer, or specifications writer, for the bid shall review the submission provided by the bidder to determine whether the product or good is an Equivalent to the bid specification. The County's Architect/Engineer or specifications writer shall have the final decision on whether a bidder's submitted product specifications are an Equivalent to the named product(s) or good(s) in the bid.

21. WORKER AND COMMUNITY RIGHT TO KNOW

- 21.1** The successful bidder shall comply with all provisions of the Worker and Community Right to Know Act, N.J.S.A. 34:5A-1 et seq., as well as the regulations under the Act (N.J.A.C. 8:59-1.1 et seq.).

22. COOPERATIVE PRICING

- 22.1** If this bid is being issued under the **Camden County Cooperative Pricing System, System Identifier No. 57-CCCPS**, then each bidder must read the **Rules and Instructions for Bids Under the Camden County Cooperative Pricing System** attached hereto and indicate on **Exhibit L** whether its bid proposal is extended or not extended to registered system members (other agencies) by checking the appropriate box.

IMPORTANT NOTICE: A bidder's failure to complete Exhibit L in the case of a bid for the Camden County Cooperative Pricing System shall be deemed to be an extension of prices by that bidder to registered system members (other agencies).

23. BIDS FOR THE PURCHASE OF TEXTILES AND ITEMS OF APPAREL

In accordance with Resolution No. 55 of the Camden County Board of Chosen Freeholders adopted on May 21, 1998, the following terms and conditions shall apply to all bids for the purchase of textiles and/or items of apparel:

23.1 Disclosure of all subcontractors and sites

Each bidder shall set forth in **Exhibit M** of its bid response the name and address of each subcontractor to be used in the provision of the goods or services which are the subject of this bid. Additionally, each bidder shall set forth in **Exhibit M** of its bid the name and address of all locations, including subcontractor locations, substantially involved in the production of the goods or services which are the subject of this bid. Such information shall be considered public information.

23.2 Certification of Compliance.

Bidders shall certify in **Exhibit M** that each location, including subcontractor locations, substantially involved in producing or distributing such goods meet the following standards:

a. Compensation. Wage and benefit levels must be sufficient to meet basic needs and provide some discretionary income for a family of 4 (a "living wage"). For employment within the United States, this shall mean wages of at least \$7 per hour in 1997 dollars, along with affordable family health benefits and company-paid pension benefits typical of responsible employers.

b. Rights. The company respects workers' rights to speak up about working conditions without fear of retaliation, and to form unions of their own choosing without employer resistance. Due process and just cause procedures are used for discipline or discharge. The company complies with all laws, regulations, and ILO standards governing the workplace. The company does not use child labor, forced labor, or corporal punishment. The company does not discriminate in hiring, promotion or compensation based on race, national origin, religion, gender, sexual preference, union affiliation, or political affiliation.

c. Safety and Health. The company provides a safe and healthy work environment.

23.3 Correction and remediation of violations; Proof of compliance

The County may, at its discretion, require correction and remediation of violations of the standards listed above prior to renewing commerce with the contractor. The County may require further proof of compliance with the aforementioned standards. Upon the County's request, the contractor or subcontractor shall make all relevant records available to the County or its designee.

24. COMPLIANCE WITH PUBLIC WORKS CONTRACTOR REGISTRATION ACT

The bidder shall comply with The Public Works Contractor Registration Act, P.L. 1999, c. 238 on all bids for public works as defined in the law. Proof of compliance with this law, when applicable, must be submitted prior to award of contract. The bidder and its named specialty trade sub-contractor(s) listed in Exhibit N (see below), shall provide proof of compliance prior to award of contract or bid will be rejected as non-compliant. Questions regarding this law may be directed to the New Jersey Department of Labor and Workforce Development, Contractor Registration Unit at 609-292-9464. **The County strongly recommends that each bidder provide its public works contractor registration certificate (and certificates for each Exhibit N subcontractor) with submission of bids.**

25. REQUEST FOR TAXPAYER IDENTIFICATION NUMBER AND CERTIFICATION

Upon execution of the contract with the County, the successful bidder shall be required to complete and submit IRS Form W-9, Request For Taxpayer Identification Number And Certification to the County's Division of Accounts Payable, 520 Market Street, 10th Floor, Camden, New Jersey 08102. This requirement shall only apply to the successful bidder. Failure by the successful bidder to meet this requirement shall result in the County withholding such funds as required by IRS regulations.

26. BIDS FOR CONSTRUCTION/DISCLOSURE OF SUBCONTRACTORS

26.1 Definition of Construction Bid.

"Construction" means construction, alteration or repair of any public building when the entire cost of the work will exceed the bid threshold. In addition to construction bids, the County specifically requires that bidders identify all subcontractors in specialty trade categories for all bids where such specialty trades may be required (see below and Section 35).

26.2 Disclosure of Subcontractors.

a. Bidders must list in **Exhibit N**, all subcontractors that they intend to use in the specialty trade categories of: Plumbing and Gas Fitting, and All Kindred Work; Steam Power Plants, Steam and Hot Water Heating and Ventilating Apparatus, and All Kindred Work; Electrical Work; and Structural Steel and Ornamental Iron Work, as required to be listed by N.J.S.A. 40A:11-16. **FAILURE TO LIST THESE REQUIRED SUBCONTRACTORS SHALL BE CAUSE FOR REJECTION OF BID.** Bidders with questions regarding this process should consult their counsel.

b. Substitution of subcontractors shall be permitted only in cases of impossibility, e.g., the death of the subcontractor or where the subcontractor goes out of business.

c. The bidder's proposal will be rejected if the subcontractors listed do not comply with the requirements for the designated work tasks.

d. A general contractor that intends to utilize a specific subcontractor to perform work in one or more of the above-referenced specialty trade categories set forth in N.J.S.A. 40A:11-16 (See **Exhibit N**), shall provide the required information about that subcontractor in the appropriate spaces for each specialty trade category applicable to the contract.

A general contractor that intends to perform work in one or more of the above-referenced specialty trade categories set forth in N.J.S.A. 40A:11-16 (See **Exhibit N**) through the use of its own employees or the general contractor himself rather than through utilization of a subcontractor shall write the word "In-House" next to each applicable category and then insert the name, and the license number where required, of each such employee of the general contractor or the general contractor himself in the appropriate spaces for each specialty trade category applicable to the contract.

If the contract does not involve any of the above-referenced specialty trade categories set forth in N.J.S.A. 40A:11-16, the contractor shall insert the word "None" in each appropriate space provided.

e. If the bidder proposes to perform **plumbing, gas fitting and all kindred work** with its own personnel, it shall follow the requirements of N.J.S.A. 45:14C-1 et seq. and N.J.A.C. 13:32-1.1 et seq.

f. If the bidder proposes to perform **electrical work** with its own personnel, it shall follow the requirements of N.J.S.A. 45:5A-1 et seq. and N.J.A.C. 13:31-1.1 et seq.

27. SIGNIFICANT PUBLIC WORKS PROJECTS

By Resolution No. 71 adopted June 17, 2004, the Board of Chosen Freeholders of the County of Camden (Board) set the following bid specification requirements for significant County public works projects:

- a. "Significant Public Works Project" means construction, reconstruction, demolition, alteration, or repair work, or maintenance work, including painting and decorating, done under contract and paid for in whole or in part out of Camden County funds which equal or exceed the sum of \$25,000.00, which sum shall be adjusted in accordance with the bid threshold provision of N.J.S.A. 40A:11-3 as amended from time to time.
- b. All bids on significant public works projects shall include an apprenticeship program in the appropriate trade(s), registered in the State of New Jersey, with the United States Department of Labor, Bureau of Apprenticeship and Training or contain a statement of agreement not to employ any worker of less than journeyman status on the project; and
- c. A detailed statement of compliance shall be completed by the bidder and the specialty trade subcontractors set forth in Paragraph 26 above and identified in Exhibit N and submitted as a material requirement of the bid for the bid to be accepted. This statement shall be made in Exhibit O. Additionally, the successful bidder must submit a detailed statement of compliance as set forth in **Exhibit O** for **all other subcontractors** prior to the commencement of work by said subcontractors.
- d. The County of Camden may refuse to award a contract to a person or entity submitting a bid or proposal if that person or entity has filed or submitted false information or failed to file or submit the information required by Resolution No. 71 adopted by the Board on June 17, 2004. The County may require further proof of compliance with the standards set forth above. Upon request, the contractor shall make all relevant records available to the County or its designee.

28. NO DAMAGES FOR DELAY

Extension of the contract time shall be the sole remedy of the Contractor for any: (1) delay in the commencement, prosecution or completion of the work; (2) hindrance or obstruction in the performance of the work; (3) loss of productivity; or (4) other similar claims whether or not such delays are foreseeable, unless such delay is due to the County's negligence, bad faith, active interference, tortious conduct or other reasons unanticipated by the parties that delay the contractor's performance, in accordance with the provisions of N.J.S.A. 40A:11-16.7. The aforementioned shall apply to any contract awarded as the result of this bid including but not limited to contracts for construction, goods, or services.

29. ALTERNATIVE DISPUTE RESOLUTION

For construction contracts, as defined in N.J.S.A. 40A:11-50, disputes arising under the contract shall be submitted to mediation or non-binding arbitration pursuant to industry standards prior to being submitted to a court for adjudication.

30. COMPLIANCE WITH THE AMERICANS WITH DISABILITIES ACT

The successful bidder shall comply with the mandatory language of the Americans With Disabilities Act as set forth in **Exhibit P** attached hereto.

31. COMPLIANCE WITH CONTRACTOR BUSINESS REGISTRATION PROGRAM

Pursuant to N.J.S.A. 52:32-44, Camden County is prohibited from entering into a contract with an entity unless the bidder/proposer/contractor, and each subcontractor that is required by law to be named in a bid/proposal/contract has a valid Business Registration Certificate on file with the Division of Revenue and Enterprise Services within the Department of the Treasury.

Prior to contract award or authorization, the contractor shall provide the Contracting Agency with its proof of business registration and that of any named subcontractor(s).

Subcontractors named in a bid or proposal shall provide proof of business registration to the bidder, who in turn, shall provide it to the Contracting Agency prior to the time of contract, purchase order, or other contracting document is awarded or authorized.


During the course of contract performance:


- (1) The contractor shall not enter into a contract with a subcontractor unless the subcontractor first provides the contractor with a valid proof of business registration.
- (2) The contractor shall maintain and submit to the Contracting Agency a list of subcontractors and their addresses that may be updated from time to time.
- (3) The contractor and any subcontractor providing goods or performing services under the contract, and each of their affiliates, shall collect and remit to the Director of the Division of Taxation in the Department of Treasury, the use tax due pursuant to the Sales and Use Tax Act, (N.J.S.A. 54:32B-1 et seq.) on all sales of tangible personal property delivered in the State. Any questions in this regard can be directed to the Division of Taxation at (609) 292-6400. Form NJ-REG can be filed online at www.state.nj.us/treasury/revenue/busregcert.shtml.

Before final payment is made under the contract, the contractor shall submit to the Contracting Agency a complete and accurate list of all subcontractors used and their addresses.

Pursuant to N.J.S.A. 54:49-4.1, a business organization that fails to provide a copy of a business registration as required, or that provides false business registration information, shall be liable for a penalty of \$25 for each day of violation, not to exceed \$50,000, for each proof of business registration not properly provided under a contract with a contracting agency.

The County strongly recommends that each bidder provide its BRC (and BRC's for each subcontractor) with submission of bids.

STATE OF NEW JERSEY BUSINESS REGISTRATION CERTIFICATE FOR STATE AGENCY AND CASINO SERVICE CONTRACTORS		DEPARTMENT OF TREASURY DIVISION OF REVENUE PO BOX 252 TRENTON, N.J. 08646-0252
TAXPAYER NAME:	TRADE NAME:	
TAX REGISTRATION TEST ACCOUNT	CLIENT REGISTRATION	
TAXPAYER IDENTIFICATION#:	SEQUENCE NUMBER:	
970-097-382/500	0107330	
ADDRESS:	ISSUANCE DATE:	
847 ROEBLING AVE TRENTON NJ 08611	07/14/04	
EFFECTIVE DATE:	 Acting Director	
01/01/01		
FORM-BRC(08-01)	This Certificate is NOT assignable or transferable. It must be conspicuously displayed at above address.	

 STATE OF NEW JERSEY BUSINESS REGISTRATION CERTIFICATE	
Taxpayer Name:	TAX REG TEST ACCOUNT
Trade Name:	
Address:	847 ROEBLING AVE TRENTON, NJ 08611
Certificate Number:	1093907
Date of Issuance:	October 14, 2004
For Office Use Only:	
20041014112823533	

32. ACKNOWLEDGEMENT OF RECEIPT OF ADDENDA

The bidder shall complete, sign and return with bid **Exhibit Q** attached hereto. Form must be completed and returned with bid regardless of whether addenda were issued by the County.

33. UNIFORMED LAW ENFORCEMENT OFFICERS REQUIREMENT FORM

Pursuant to N.J.S.A. 40A:11-23.1(c) if uniformed law enforcement officers are required for the project, **Exhibit R** will be completed by the County and indicate a good faith estimate of the total cost of traffic control personnel, vehicles, equipment, administrative, or any other costs associated with additional traffic control requirements as determined by the County with input from any other public entity affected by the project. These estimated amounts reflect those costs above and beyond the bidder's traffic control costs.

34. APPROVAL AND CERTIFICATION OF BILLING

Authorization for payment of periodic billing, final payments or retainage monies requires approval and certification by formal resolution of the Camden County Board of Chosen

Freeholders. Pursuant to P.L. 2006, c. 96, all billing amounts due under a contract with the successful bidder and all required purchasing documents must be received at least ten (10) days in advance of the next scheduled public meeting of Board of Freeholders for the month in which payment is requested. Approved and certified amounts due will be paid during the County's subsequent payment cycle.

35. PROPRIETARY GOODS

____ County to Check if applicable

If checked off above, the goods set forth in the technical specifications have been certified as proprietary goods in accordance with the Local Public Contracts Law, N.J.S.A. 40A:11-1 et seq. No substitutions or equivalents will be accepted. Please see the technical specifications attached hereto.

36. CONTRACTS WHERE ASPHALT WORK IS INCLUDED IN SPECIFICATIONS

P.L. 2015, c.201 requires the inclusion of a pay item for an asphalt price adjustment for any bid specification that includes the purchase or use of hot mix asphalt; provides for application of a fuel price adjustment where a pay item is eligible (see NJDOT Section 160.03.01, where applicable); for contracts issued for more than 1,000 tons, requires the price adjustment pay item be applied to each ton of hot mix asphalt purchased and used, not just the tonnage exceeding the 1,000 ton threshold; clarifies that the term "hot mix asphalt" includes equivalent asphalt cement-based products (e.g. warm mix asphalt); prohibits disaggregation of quantities to avoid compliance with P.L. 2015, c.201.

37. Pursuant to N.J.S.A. 40A:11-16.6, all construction contracts issued by the County when the total price of the originally awarded contract equals or exceeds \$5,000,000.00, shall allow for value engineering construction change orders to be approved after the award of the contract.

38. PERMISSION FOR BIDDER TO WITHDRAW A PUBLIC WORKS BID DUE TO A MISTAKE IN CERTAIN CIRCUMSTANCES

Effective March 4, 2011, N.J.S.A. 40A:11-23.3 authorizes a bidder to request withdrawal of a **public works bid** due to a mistake on the part of the bidder. A mistake is defined by N.J.S.A. 40A:11-2(42) as a clerical error that is an **unintentional and substantial computational error or an unintentional omission of a substantial quantity of labor, material, or both, from the final bid computation.**

A bidder claiming a mistake under N.J.S.A. 40A:11-23.3 must submit a request for withdrawal, **in writing**, by certified or registered mail to the Camden County Purchasing Agent, 520 Market Street, 17th Floor, Camden, New Jersey, 08102. Written requests must be provided within five business days after the receipt and opening of the bids. The bid withdrawal shall be effective as of the postmark of the certified or registered mailing.

A bidder's request to withdraw the bid shall contain evidence, including any pertinent documents, demonstrating that a mistake was made. Such documents and relevant written information **shall** be reviewed and evaluated by the public owner's designated staff pursuant to the statutory criteria of N.J.S.A. 40A:11-23.3.

The County will not consider any written request for a bid withdrawal for a mistake as defined by N.J.S.A. 40A:11-2(42), by a bidder in the preparation of a bid proposal unless the postmark of the certified or registered mailing is within five business days following the opening of bids.

If a bidder is granted a bid withdrawal, the bidder shall be disqualified from future bidding on the same project, including whenever all bids are rejected pursuant to N.J.S.A. 40A:11-13.2

39. N.J.A.C. § 17:44-2.2 AUTHORITY TO AUDIT OR REVIEW CONTRACT RECORDS

(a) Relevant records of private vendors or other persons entering in to contracts with covered entities are subject to audit or review by OSC pursuant to N.J.S.A. 52:15C-14(d).

(b) As of November 15, 2010, all covered entities shall insert the following language in any new contract:

"(The contract partner) shall maintain all documentation related to products, transactions or services under this contract for a period of five years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request."

40. NEW JERSEY ANTI-DISCRIMINATION PROVISIONS: N.J.S.A. 10:2-1 et seq.

If awarded a contract, the contractor agrees to abide by the New Jersey anti-discrimination provisions contained in N.J.S.A. 10:2-1 et seq. See Exhibit T.

END OF INSTRUCTIONS TO BIDDERS / EXHIBITS BEGIN ON NEXT PAGE

EXHIBIT A
SAMPLE FORM OF BID BOND

A. We, the undersigned

_____ as Principal and
_____ as Surety, are hereby held and firmly bound unto
_____ in the penal sum of _____ Dollars

(\$_____), lawful money of the United States for the payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns. Signed this _____ day of _____, 20 _____.

B. THE CONDITION of the above obligation is such that whereas the Principal has submitted to the _____,
a certain bid attached hereto and hereby made a part of hereto and hereby made a part of hereof, to enter in to a contract in writing for the (insert type of work)
_____.

C. **NOW THEREFORE:**

If said bid shall be rejected, or in the alternate, if said bid shall be accepted and the Principal shall execute and deliver a contract in the form of Agreement required by the Bid Documents and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all respects perform the agreement created by the acceptance of said bid. Then this obligation shall be void, otherwise the same shall remain in force and effect, it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

D. THE SURETY for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall in no way be impaired or affected by an extension of the time within the "OBLIGEE" may accept such bid. And said Surety does hereby waive notice of any such extension.

E. IN WITNESS, WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as corporations have caused their corporate seals to be hereto fixed and these presents to be signed by their proper officers, the day and year set forth above.

_____(L.S.)
PRINCIPAL

SURETY

(SEAL)

BY

NOTE: Bid Bond must be signed by an authorized agent or representative of a surety company and not by the individual or company submitting the bid.

EXHIBIT B

SAMPLE FORM OF CONSENT OF SURETY

BOND NO. _____
(INSERT YOUR BOND NO. HERE)

The _____, a Corporation organized and
(NAME OF YOUR INSURANCE COMPANY)

existing under the laws of the State of _____,

and licensed to do business in the State of New Jersey, hereby consents and agrees that if the
contract for: _____ (INSERT BID NO.)

_____ AND ITEMS
WHICH YOU ARE BIDDING).

be awarded to _____.
(NAME OF YOUR COMPANY)

the undersigned Corporation agrees with the said County of Camden, Courthouse, 520 Market Street,
Camden, New Jersey 08102 to execute the final bond as required by the specifications and to become
the surety in the full amount of the price bid for the faithful performance of the contract.

In Witness, Whereof, the undersigned Corporation has caused this agreement to be signed by its duly
authorized representative and its Corporate Seal to be hereto affixed this _____ day of
_____, 20 ____.

The _____
(NAME OF INSURANCE COMPANY)

By _____
(ATTORNEY-IN-FACT)

Countersigned by:

NOTE: **Consent of Surety must be signed by an authorized agent or
representative of a surety company and not by the individual or
company submitting the bid.**

EXHIBIT C

SAMPLE FORM OF PERFORMANCE BOND

We, the Undersigned

as Principal, and _____

a Corporation organized and existing under the laws of the State of _____ and
authorized to do business in the State of New Jersey as surety are held and firmly bound unto
_____ hereinafter called the Owner as hereinafter set forth, in the full and
just several sums of

(a) _____
_____ Dollars (\$ _____)
for faithful performance of the contract as hereinafter designated in Paragraph "A" and

(b) _____
_____ Dollars (\$ _____)
for payment of labor and material as hereinafter designated in Paragraph "B" and

(c) _____
_____ Dollars (\$ _____)
for maintenance as hereinafter designated in Paragraph "C"; lawful money of the United States of
America; to be paid to the Owner, or its Assigns, to which payment well and truly to be made and done,
we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by
these presents.

Sealed with our respective seals and dated this _____ day of
_____, 20 .

WHEREAS, the above bonded Principal has entered into a contract with the
Owner dated the _____ day of _____, 20
for _____

upon certain terms and conditions in said contract more particularly mentioned; and

WHEREAS, it is one of the conditions of the award of the Owner pursuant to which said contract
is about to be entered into, that these presents be executed.

(Sample Form of Performance Bond – continued)

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH:

A. That if the Principal shall faithfully perform the contract on its part to be performed according to the terms of said contract, or any changes or modifications therein made as therein provided; and shall indemnify and save harmless the party of the first part mentioned in the contract aforesaid, its officers, agents and servants, and each and every one of them against and from all suits and costs of every kind and description and from all damages which the said party of the first part in said contract mentioned, or any of its officers, agents or servants may be put by reason of injury to the person or property of others resulting from the performance of said work or through the negligence of the said party of the second part to said contract, or through any improper or defective machinery, implements or appliances used by the said party of the second part in the aforesaid work or through any act or omission on the part of the said party of the second part or its agents, servants or employees, and shall further indemnify and save harmless the party of the first part mentioned in the contract aforesaid its officers, agents and servants from all suits and actions of any kind or character whatsoever, which may be brought or instituted by any subcontractor, materialman or laborer who has performed work or furnished materials in or about the work required to be done pursuant to the said contract or by or on account of, any claims or amount recovered for any infringement of patent, trademark, or copyright; then this part of this obligation designated as part "A" shall be void; otherwise the same shall remain in full force and effect, it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

B. That if the said Principal shall pay all lawful claims of subcontractors, materialmen, laborers, persons, firms or corporations for labor performed or materials, provisions, provender or other supplies or items, fuels, oils, implements or machinery furnished, used or consumed in the carrying forward, performing or completing of said contract; we agreeing and assenting that this undertaking shall be for the benefit of any subcontractor, materialman, laborer, person, firm or corporation having a just claim, as well as for the obligee herein; whether or not the said material and labor enter into and become component parts of the work or improvement or in any amendment, extension or addition to said contract, then this part of this obligation designated part "B", shall be void, otherwise the same shall remain in full force and effect.

C. That if the said Principal shall well and truly keep and perform all the obligations, agreements, terms, and conditions of such contract, on the Principal's part to be kept and performed and said Principal shall be responsible for poor workmanship done or poor materials furnished under said contract for a period of one year from the date of the completion and final acceptance by the party of the first part and mentioned in the contract, and said Principal shall pay for all labor performed and furnished and for all materials used in correcting any poor workmanship done and replacing any poor materials furnished, then this part of this obligation designated part "C", shall be void; otherwise the same shall remain in full force and effect.

It is further agreed that any alterations which may be made in the terms of the contract or in the work to be done or materials to be furnished or labor to be supplied or performed under it or the giving by the Owner of any extension of time for the performance of the Contract or the reduction of the retained percentages as permitted by the Contract or any other forbearance on the part of either the Owner or the Principal to the other, shall not in any way release the Principal and the

(Sample Form of Performance Bond – continued)

Surety or Sureties or either or any of them, their heirs, executors, administrators, successors or assigns, from their liability hereunder, notice to the Surety or Sureties of any alterations, extension or forbearance being hereby waived.

It is further agreed that in case of default in, and/or any action arising out of rights and liabilities secured by this obligation or any part hereto or any person claiming by or through it, either may use for the purpose of establishing its, or their claim, a copy of this obligation certified by the Owner, and the action, or actions, if any, arising on the within bond, shall not be a bar to any subsequent action that may arise through any liability incurred in any other action herein, and based upon any other part of this obligation.

IN WITNESS, WHEREOF, the said Principal and Surety have duly executed this bond under their seals the day and year above written.

If Principal is an individual:

Witness:

By _____ (SEAL)

Surety

By _____
Attorney-in-fact
(Corporate Seal)

If Principal is a partnership:

Witness:

Principal

Partner (SEAL)

Partner (SEAL)

Surety

By _____
Attorney-in-fact
(Corporate Seal)

(Sample Form of Performance Bond – continued)

If Principal is a corporation:

Attest:

Secretary

Corporate Seal:

Attest:

Principal

By _____
President

By _____
Attorney-in-fact
(Corporate Seal)

Approved as to Form _____, 20____

Assistant County Counsel

EXHIBIT D

SAMPLE FORM OF TERMS OF LETTER OF CREDIT

1. **AMOUNT:** The amount of this letter of credit shall be for the sum of _____.

(Amount of Contract)

2. **TERM:** The term of this letter of credit shall be in effect and irrevocable for a period commencing on the date of execution of the agreement between the County of Camden and _____.

(Name of Contractor)

and terminating one (1) year after the date of completion and final acceptance by the County of the work performed pursuant to Camden County Bid No.:

_____.

(Bid No. and description of services/material to be provided)

3. **CAUSES FOR PROCEEDING AGAINST LETTER OF CREDIT:** The County shall have the absolute right to proceed against this letter of credit if:

(a) Contractor shall fail to faithfully perform according to the terms of the contract and Camden County Bid No. _____, or any changes or modifications therein made as therein provided; or Contractor shall fail to indemnify and save harmless the County of Camden, its officers, agents and servants, and each and every one of them against and from all suits and costs of every kind and description and from all damages which the County, or any of its officers, agents or servants may be put by reason of injury to the person or property of others resulting from the performance of said work or through the negligence of Contractor, or through any improper or defective machinery, implements or appliances used by contractor in the aforesaid work or through any act or omission on the part of Contractor, its agents, servants or employees; or contractor shall fail to further indemnify and save harmless the County, its officers, agents and servants from all suits and actions of any kind or character whatsoever, which may be brought or instituted by any subcontractors, materialman or laborer who has performed work or furnished materials in or about the work required to be done pursuant to said contract, or by or on account of, any claims or amount recovered for any infringement of patent, trademark, or copyright; or _____

(Name of Bank)

agreeing and assenting that this undertaking shall be for the benefit of any subcontractor, materialman, laborer, person, firm or corporation having a just claim, as well as for the County of Camden, whether or not the said material and labor enter into and become component parts of the work or improvement or in any amendment, extension or addition to said contract; or

(b) Contractor shall fail to pay all lawful sums of subcontractors, materialman, laborers, persons, firms or corporations for labor performed or materials, provisions, provender or other supplies or teams, fuels, oils, implements or machinery furnished, used or consumed in the carrying forward, performing or completing of said contract; or

(c) Contractor shall fail to well and truly keep and perform all the obligations, agreements, terms and conditions of such contract, on its part to be kept and performed and Contractor shall be responsible for poor workmanship done or poor materials furnished under said contract for a period of one (1) year from the date of the completion and final acceptance by the County of Camden, and Contractor shall pay for all labor performed and furnished and for all materials used in correcting any poor workmanship done and replacing any poor materials furnished.

It is further agreed that any alterations which may be made in the terms of the contract or in the work to be done or materials to be furnished or labor to be supplied or performed under it or the giving by the County of Camden of any extension of time for the performance of the contract shall not in any way release Contractor, its heirs, executors, administrators, successors or assigns, from its liability hereunder.

NOTE: Letter of Credit must be signed by an authorized agent or representative of a bank or similar financial institution and not by the individual or company submitting the bid.

EXHIBIT E
STATEMENT OF OWNERSHIP DISCLOSURE

N.J.S.A. 52:25-24.2 (P.L. 1977, c.33, as amended by P.L. 2016, c.43)

This statement shall be completed, certified to, and included with all Bid and Competitive Contracting RFP submissions. Failure to submit the required information is cause for automatic rejection of the bid or proposal.

Name of Organization: _____

Organization Address: _____

Part I Check the box that represents the type of business organization:

- ☐ Sole Proprietorship (skip Parts II and III, execute certification in Part IV)
- ☐ Non-Profit Corporation (skip Parts II and III, execute certification in Part IV)
- ☐ For-Profit Corporation (any type) ☐ Limited Liability Company (LLC)
- ☐ Partnership ☐ Limited Partnership ☐ Limited Liability Partnership (LLP)
- ☐ Other (be specific): _____

Part II

- ☐ The list below contains the names and **HOME addresses** of all individual stockholders in the corporation who own 10 percent or more of its stock, of any class, or of all individual partners in the partnership who own a 10 percent or greater interest therein, or of all members in the limited liability company who own a 10 percent or greater interest therein. (**COMPLETE THE LIST BELOW IN THIS SECTION**)

OR

- ☐ No one stockholder in the corporation owns 10 percent or more of its stock, of any class, or no individual partner in the partnership owns a 10 percent or greater interest therein, or no member in the limited liability company owns a 10 percent or greater interest therein. (**SKIP TO PART IV**)

(Please attach additional sheets if more space is needed):

Name of Individual or Business Entity	Must list Home Address for Individuals

Part III DISCLOSURE OF 10% OR GREATER OWNERSHIP IN THE STOCKHOLDERS, PARTNERS OR LLC MEMBERS LISTED IN PART II

If a bidder has a direct or indirect parent entity which is publicly traded, and any person holds a 10 percent or greater beneficial interest in the publicly traded parent entity as of the last annual federal Security and Exchange Commission (SEC) or foreign equivalent filing, ownership disclosure can be met by providing links to the website(s) containing the last annual filing(s) with the federal Securities and Exchange Commission (or foreign equivalent) that contain the name and address of each person holding a 10% or greater beneficial interest in the publicly traded parent entity, along with the relevant page numbers of the filing(s) that contain the information on each such person. **Attach additional sheets if more space is needed.**

Website (URL) containing the last annual SEC (or foreign equivalent) filing	Page #'s

Please list the names and **HOME addresses** of each stockholder, partner or member owning a 10 percent or greater interest in any corresponding corporation, partnership and/or limited liability company (LLC) listed in Part II **other than for any publicly traded parent entities referenced above.** The disclosure shall be continued until names and addresses of every noncorporate stockholder, and individual partner, and member exceeding the 10 percent ownership criteria established pursuant to N.J.S.A. 52:25-24.2 has been listed. **Attach additional sheets if more space is needed.**

Stockholder/Partner/Member and Corresponding Entity Listed in Part II	Home Address (for Individuals) Business Address (for Corporate Entity)

Part IV Certification

I, being duly sworn upon my oath, hereby represent that the foregoing information and any attachments thereto to the best of my knowledge are true and complete. I acknowledge: that I am authorized to execute this certification on behalf of the bidder/proposer; that **Camden County** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the completion of any contracts with **Camden County** to notify **Camden County** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with **Camden County** permitting **Camden County** to declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print):		Title:	
Signature:		Date:	

EXHIBIT F

NON-COLLUSION AFFIDAVIT

STATE OF)
COUNTY OF)

I, _____ of the City of _____ in the County of, _____
and the State of _____ of full age, being dully sworn according to law on my oath depose and say
that: I am _____ of the firm of _____ the bidder making this Proposal for the above named project,
and that I executed the said Proposal with full authority to do so; that said bidder had not, directly or
indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in
restraint of free, competitive bidding in connection with the above named project; and that all
statements contained in said Proposal and in this affidavit are true and correct, and made with full
knowledge that the State of New Jersey relies upon the truth of the statements contained in said
Proposal and in the statements contained in this affidavit in awarding the contract for the said project.

I further warrant that no person or selling agency has been employed or retained to solicit or secure
such contract upon an agreement or understanding for a commission, percentage, brokerage or
contingent fee, except bona fide employees or bona fide established commercial or selling agencies
maintained by _____ (N.J.S.A. 52:34-15)

(Name of Contractor)

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

Notary Public

(Also type or print name of bidder
under signature)

EXHIBIT G

MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE N.J.S.A. 10:5-31 et seq. (P.L. 1975, C. 127) N.J.A.C. 17:27

GOODS, PROFESSIONAL SERVICE AND GENERAL SERVICE CONTRACTS

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

The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity 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 by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

The contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union of the contractor's commitments under this chapter and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

The contractor or subcontractor agrees to make good faith efforts to meet targeted county employment goals established in accordance with N.J.A.C. 17:27-5.2.

The contractor or subcontractor agrees to inform in writing its appropriate recruitment agencies including, but not limited to, employment agencies, placement bureaus, colleges, universities, and labor unions, that it does not discriminate on the basis of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex, and that it will discontinue the use of any recruitment agency which engages in direct or indirect discriminatory practices.

The contractor or subcontractor agrees to revise any of its testing procedures, if necessary, to assure that all personnel testing conforms with the principles of job-related testing, as established by

the statutes and court decisions of the State of New Jersey and as established by applicable Federal law and applicable Federal court decisions.

In conforming with the targeted employment goals, the contractor or subcontractor agrees to review all procedures relating to transfer, upgrading, downgrading and layoff to ensure that all such actions are taken without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex, consistent with the statutes and court decisions of the State of New Jersey, and applicable Federal law and applicable Federal court decisions.

The contractor shall submit to the public agency, after notification of award but prior to execution of a goods and services contract, one of the following three documents:

1. Letter of Federal Affirmative Action Plan Approval
2. Certificate of Employee Information Report
3. Employee Information Report Form AA302 (electronically provided by the Division and distributed to the public agency through the Division's website at www.state.nj.us/treasury/contract_compliance)

The contractor and its subcontractors shall furnish such reports or other documents to the Division of Purchase & Property, CCAU, EEO Monitoring Program as may be requested by the office from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Division of Public Contracts Equal Employment Opportunity Compliance for conducting a compliance investigation pursuant to N.J.A.C. 17:27-1.1 et seq.

EXHIBIT H

MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE N.J.S.A. 10:5-31 et seq. (P.L. 1975, C. 127) N.J.A.C. 17:27

CONSTRUCTION CONTRACTS

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

The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, up-grading, 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 by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

The contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer, pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

When hiring or scheduling workers in each construction trade, the contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by N.J.A.C. 17:27-7.2; provided, however, that the Division may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by the following provisions, A, B and C, as long as the Dept. of LWD, Construction EEO Monitoring Program is satisfied that the contractor or subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Dept. of LWD, Construction EEO Monitoring Program, that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with N.J.A.C. 17:27-7.2. The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:

(A) If the contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et. seq., as supplemented and amended from time to time and the Americans with Disabilities Act. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the contractor or subcontractor agrees to afford equal employment opportunities minority and women workers directly, consistent with this chapter. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities as specified in this chapter, the contractor or subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the hiring or scheduling procedures prescribed under (B) below; and the contractor or subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.

(B) If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (A) above, or if the contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor agrees to take the following actions:

(1) To notify the public agency compliance officer, the Dept. of LWD, Construction EEO Monitoring Program, and minority and women referral organizations listed by the Division pursuant to N.J.A.C. 17:27-5.3, of its workforce needs, and request referral of minority and women workers;

(2) To notify any minority and women workers who have been listed with it as awaiting available vacancies;

(3) Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;

(4) To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State Training and Employment Service and other approved referral sources in the area;

(5) If it is necessary to lay off some of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and non-discrimination standards set forth in this regulation, as well as with applicable Federal and State court decisions;

(6) To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:

(i) The contractor or subcontractor shall interview the referred minority or women worker.

(ii) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the contractor or subcontractor shall in good faith determine the qualifications of such individuals. The contractor or subcontractor shall hire or schedule those individuals who satisfy appropriate

qualification standards in conformity with the equal employment opportunity and non-discrimination principles set forth in this chapter. However, a contractor or subcontractor shall determine that the individual at least possesses the requisite skills, and experience recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Dept. of LWD, Construction EEO Monitoring Program. If necessary, the contractor or subcontractor shall hire or schedule minority and women workers who qualify as trainees pursuant to these rules. All of the requirements, however, are limited by the provisions of (C) below.

(iii) The name of any interested women or minority individual shall be maintained on a waiting list and shall be considered for employment as described in (i) above, whenever vacancies occur. At the request of the Dept. of LWD, Construction EEO Monitoring Program, the contractor or subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.

(iv) If, for any reason, said contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Dept. of LWD, Construction EEO Monitoring Program.

(7) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Dept. of LWD, Construction EEO Monitoring Program and submitted promptly to the Dept. of LWD, Construction EEO Monitoring Program upon request.

(C) The contractor or subcontractor agrees that nothing contained in (B) above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the targeted county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to (B) above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of (B) above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

After notification of award, but prior to signing a construction contract, the contractor shall submit to the public agency compliance officer and the Dept. of LWD, Construction EEO Monitoring Program an initial project workforce report (Form AA 201) electronically provided to the public agency by the Dept. of LWD, Construction EEO Monitoring Program, through its website, for distribution to and completion by the contractor, in accordance with N.J.A.C. 17:27-7. The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Division and to the public agency compliance officer.

The contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is

necessary, for on-the-job and/or off-the-job programs for outreach and training of minorities and women.

(D) The contractor and its subcontractors shall furnish such reports or other documents to the Dept. of LWD, Construction EEO Monitoring Program as may be requested by the Dept. of LWD, Construction EEO Monitoring Program from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Dept. of LWD, Construction EEO Monitoring Program for conducting a compliance investigation pursuant to N.J.A.C. 17:27-1.1 et seq.

EXHIBIT I

QUESTIONNAIRE ON SUPPLY/SERVICE CONTRACTS

Please complete this questionnaire and submit it with your bid. Any necessary forms will be sent to you by the County upon award.

1. Our Company has a Federal Affirmative Action Plan Approval.

YES _____ NO _____

A. If yes, submit a photostatic copy of said approval.

B. If no, submit a photostatic copy of the New Jersey Certificate of Employee Information Report.

NONE OF THE ABOVE _____

2. We have neither State nor Federal Affirmative Action evidence. Please send us Form AA-302 (Affirmative Action Employee Information Report application). (Check if applicable _____).

I certify that the above information is correct to the best of my knowledge.

NAME: _____

SIGNATURE: _____

TITLE: _____

DATE: _____

AN EQUAL OPPORTUNITY EMPLOYER

EXHIBIT J

AFFIRMATIVE ACTION PLAN MBE/WBE TRACKING FORM

Definitions:

A **Minority Business Enterprise (MBE)** is defined in the Camden County Affirmative Action Plan as "a business which is independently owned and operated and is at least 51% owned and controlled by minority group members". Minority group members are defined in the Camden County Affirmative Action Plan as "persons who are Black, Hispanic, Portuguese, Asian-American, American Indian or Alaskan Natives"

A **Women Business (WBE)** is defined in the Camden County Affirmative Action Plan as "a business which is independently owned and operated and is at least 51% owned and controlled by women".

Using the definitions above, please check the following space which best describes your firm:

- _____ **Minority Business Enterprise (MBE)**
- _____ **Women Business Enterprise (WBE)**
- _____ **Neither**

EXHIBIT K

**CERTIFICATION REGARDING THE DEBARMENT, SUSPENSION,
INELIGIBILITY AND VOLUNTARY EXCLUSION -
LOWER TIER COVERED TRANSACTIONS**

I am _____ of the firm of _____,
(your title) (name of your organization)

(address of your organization)

CHOOSE ONE OF THE FOLLOWING

- () A. I hereby certify on behalf of _____ that
(name of your organization)

neither it nor its principals are debarred, suspended, proposed for debarment, declared
ineligible, or voluntarily excluded from participation in this transaction by any federal or state
department, agency, or office.
- () B. I am unable to certify to any of the statements set forth in this certification. I have
attached an explanation to this form.

(Signature)

(Type Name & Title)

(Date)

INSTRUCTIONS FOR CERTIFICATION

1. By signing and submitting this certification, the contracting firm is providing the certification as set out below.
2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the contracting firm knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government and/or State Government, the County may pursue available remedies including suspension and/or debarment.
3. The contracting firm shall provide immediate written notice to the County if at any time, it learns that its certification was erroneous when submitted or has become erroneous because of changed circumstances.
4. The terms "covered transaction", "debarred", "suspended", "ineligible", "lower tier covered transaction", "participant", "person", "primary covered transaction", "principal", and "voluntarily excluded", as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the County for assistance in obtaining a copy of those regulations.
5. The contracting firm agrees by submitting this certification that, should the covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction.
6. The contracting firm further agrees by submitting this certification that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transaction," without modification, in all subcontracts to this agreement as authorized by the County.

EXHIBIT L

EXTENSION OF PRICES TO REGISTERED SYSTEM MEMBERS (OTHER AGENCIES)

The undersigned is further:

(ONE BOX ONLY MUST BE CHECKED)

☐

WILLING to provide the item(s) herein bid upon to registered system members of the **Camden County Cooperative Pricing System, System Identifier No. 57-CCCPS**, without substitution or deviation from specifications, size, features, quality, price or availability as herein set forth. It is understood that orders will be placed directly by the registered members identified herein by separate contract, subject to the overall terms of the Master Contract to be awarded by the County of Camden, and that no additional service or delivery charges will be allowed except as permitted by these specifications.

☐

NOT WILLING to extend prices to registered system members of the **Camden County Cooperative Pricing System, System Identifier No. 57-CCCPS**, who have submitted estimates as described above. It is understood that this will not adversely affect consideration of this bid with respect to the needs of Camden County as the Lead Agency.

EXHIBIT M

**DISCLOSURE OF SUBCONTRACTORS AND SITES
AND CERTIFICATION OF COMPLIANCE**

(FOR BIDS FOR TEXTILES AND/OR ITEMS OF APPAREL ONLY)

1. **DISCLOSURE OF SUBCONTRACTORS AND SITES – SEE PARAGRAPH 23.1**

a. List the name and address of each subcontractor to be used in the provision of the goods or services which are the subject of this bid. If extra space is required, please attach additional pages as needed.

b. List the name and address of all locations, including subcontractor locations, substantially involved in the production of the goods or services which are the subject of this bid. If extra space is required, please attach additional pages as needed.

2. **CERTIFICATION OF COMPLIANCE – SEE PARAGRAPH 23.2**

I hereby certify that each of the above-referenced locations, including subcontractor locations, substantially involved in producing or distributing the goods or services which are the subject of this bid, meet the standards set forth in Paragraph 23.2 of these specifications.

(Signature)

(Type Name & Title)

(Date)

EXHIBIT N

BIDS FOR CONSTRUCTION DISCLOSURE OF SUBCONTRACTORS

Please list the subcontractors for the specialty trade categories listed below. If you intend to perform the work through your own employees or by yourself rather than through utilization of a subcontractor, write the word "In-House" next to each applicable category and insert the name, and license number where required, of each person in the appropriate spaces. If the contract does not involve a specialty trade listed below, write the word "None" in the appropriate space. For further instructions, see Paragraph 26 herein. **DO NOT LEAVE ANY SPACE BLANK.**

1. Plumbing and Gas Fitting and All Kindred Work:

Name: _____

Address: _____

License Number: _____

2. Steam Power Plants, Steam and Hot Water Heating and Ventilating Apparatus, and All Kindred Work:

Name: _____

Address: _____

License Number: Not Applicable

3. Electrical Work:

Name: _____

Address: _____

License Number: _____

4. Structural Steel and Ornamental Iron Work:

Name: _____

Address: _____

License Number: Not Applicable

EXHIBIT O

**AFFIDAVIT OF COMPLIANCE WITH INSTRUCTIONS TO BIDDERS
PARAGRAPH 27 – SIGNIFICANT PUBLIC WORKS PROJECTS**

NOTE: THE BIDDER AND EACH SPECIALTY TRADE SUBCONTRACTOR AS DEFINED IN PARAGRAPHS 26 & 27 ABOVE MUST EACH COMPLETE A SEPARATE AFFIDAVIT TO BE SUBMITTED WITH THE BID. ALL OTHER SUBCONTRACTORS MUST EACH COMPLETE THIS FORM PRIOR TO COMMENCING WORK. USE AS MANY COPIES OF THIS AFFIDAVIT FORM AS NECESSARY. Must be submitted with the bid or bid will be deemed noncompliant. Failure to submit required Exhibit O(s) is a material defect causing the bid to be rejected.

STATE OF NEW JERSEY:

SS:

COUNTY OF CAMDEN:

The undersigned, of full age, being duly sworn according to law, upon his oath, deposes and says:

1. I have read the specifications for this bid, including Instructions To Bidders, Paragraph 27 – Significant Public Works Projects, and I am aware that Camden County has adopted a resolution establishing workforce standards for significant public works projects. **I am aware that these workforce standards make the following a material requirement of this bid:**

All workers employed on this significant public works project, whether employees of the contractor or any subcontractor, shall have the benefit of the availability of an apprentice training program in the appropriate trade(s), registered in the State of New Jersey, with the United States Department of Labor, Bureau of Apprenticeship and Training.

2. **You MUST choose one of the following:**

- a. _____ My company has an apprentice training program in the appropriate trade(s), registered in the State of New Jersey, with the United States Department of Labor, Bureau of Apprenticeship and Training. The registration number for this apprentice training program is NJ (or other State) # _____ ; or
- b. _____ My company will not employ any worker of less than journeyman status on this project.

Note: Camden County will monitor the worksite to ensure compliance with this material provision and may, in its sole discretion, terminate the contract of any company found to be in violation.

Sworn to and Subscribed

before me this day

of , 20____.

NOTARY PUBLIC

MY SIGNATURE

MY NAME (PRINT OR TYPE)

COMPANY NAME

EXHIBIT P

AMERICANS WITH DISABILITIES ACT Mandatory Language

Equal Opportunity for Individuals with Disabilities.

The Contractor and the County do hereby agree that the provisions of Title II of the Americans With Disabilities Act of 1990 (the "Act") (42 U.S.C. s12101 et seq.), which prohibits discrimination on the basis of disability by public entities in all services, programs, and activities provided or made available by public entities, and the rules and regulations promulgated pursuant thereunto, are made a part of this contract. In providing any aid, benefit, or service on behalf of the County pursuant to this contract, the Contractor agrees that the performance shall be in strict compliance with the Act. In the event that the Contractor, its agents, servants, employees, or subcontractors violate or are alleged to have violated the Act during the performance of this contract, the Contractor shall defend the County in any action or administrative proceeding commenced pursuant to this Act. The Contractor shall indemnify, protect, and save harmless the County, its agents, servants, and employees from and against any and all suits, claims, losses, demands, or damages of whatever kind or nature arising out of or claimed to arise out of the alleged violation. The Contractor shall, at its own expense, appear, defend, and pay any and all charges for legal services and any and all costs and other expenses arising from such action or administrative proceeding or incurred in connection therewith. In any and all complaints brought pursuant to the County's grievance procedure, the Contractor agrees to abide by any decision of the County, which is rendered pursuant to, said grievance procedure. If any action or administrative proceeding results in an award of damages against the County or if the County incurs any expense to cure a violation of the ADA which has been brought pursuant to its grievance procedure, the Contractor shall satisfy and discharge the same at its own expense.

The County shall, as soon as practicable after a claim has been made against it, give written notice thereof to the Contractor along with full and complete particulars of the claim. If any action or administrative proceeding is brought against the County or any of its agents, servants, and employees, the County shall expeditiously forward or have forwarded to the Contractor every demand, complaint, notice, summons, pleading, or other process received by the County or its representatives.

It is expressly agreed and understood that any approval by the County of the services provided by the Contractor pursuant to this contract will not relieve the Contractor of the obligation to comply with the Act and to defend, indemnify, protect, and save harmless the Owner pursuant to this paragraph.

It is further agreed and understood that the Owner assumes no obligation to indemnify or save harmless the Contractor, its agents, servants, employees and subcontractors for any claim which may arise out of their performance of this agreement. Furthermore, the Contractor expressly understands and agrees that the provisions of this indemnification clause shall in no way limit the Contractor's obligations assumed in this agreement, nor shall they be construed to relieve the Contractor from any liability, nor preclude the Owner from taking any other actions available to it under any other provisions of this agreement or otherwise at law.

EXHIBIT Q

**COUNTY OF CAMDEN
ACKNOWLEDGEMENT OF RECEIPT OF ADDENDA**

**BIDDER REQUIRED TO COMPLETE AND RETURN FORM WITH BID REGARDLESS OF
WHETHER ADDENDA WAS ISSUED.
FAILURE TO COMPLETE AND RETURN FORM IS A FATAL DEFECT WHICH CANNOT BE
CURED AND BID WILL BE REJECTED.**

A. Bidder hereby acknowledges receipt of the following Addenda:

<u>Addendum Number</u>	<u>Dated</u>	<u>Initial</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

OR:

B. Bidder acknowledges to the best of his/her knowledge no addendum has been issued by the
County: _____ Dated _____ Initial _____

**Bidder is required to complete, sign and submit form with bid regardless of whether addenda
were issued. Failure to complete and return form is a fatal defect which cannot be cured and
bid will be rejected. See: N.J.S.A. 40A:11-23.2**

By: _____
(Print or Type Name of Authorized Individual)

Signature: _____

Title: _____

EXHIBIT R

**COUNTY OF CAMDEN
UNIFORMED LAW ENFORCEMENT OFFICERS REQUIREMENT**

Pursuant to N.J.S.A. 40A:11-23.1(c), the County has determined the following:

- () Uniformed law enforcement officers **are not required** for the project.
- () Uniformed law enforcement officers **are required** for the project.

Reasonable estimate of costs for the following:

traffic control personnel	\$ _____
vehicles	\$ _____
equipment	\$ _____
administrative	\$ _____
other (specify)	
_____	\$ _____
_____	\$ _____
_____	\$ _____
_____	\$ _____
Total costs	\$ _____

The above costs associated with additional traffic control required by the County have been reasonably estimated in cooperation and consultation with the following municipalities affected by the project.

Name of Municipality	Contact person
_____	_____
_____	_____
_____	_____
_____	_____

EXHIBIT S
DISCLOSURE OF INVESTMENT ACTIVITIES IN IRAN
PART 1: CERTIFICATION

BIDDERS MUST COMPLETE PART 1 BY CHECKING EITHER BOX. FAILURE TO CHECK ONE OF THE BOXES WILL RENDER THE PROPOSAL NON-RESPONSIVE.

Pursuant to N.J.S.A. 52:32-55, any person or entity that submits a bid or proposal or otherwise proposes to enter into or renew a contract must complete the certification below to attest, under penalty of perjury, that neither the person or entity, nor any of its parents, subsidiaries, or affiliates, is identified on the Department of Treasury's Chapter 25 list (N.J.S.A. 51:32-57) as a person or entity engaging in investment activities in Iran. The Chapter 25 list is found on the Division's website at: <http://www.state.nj.us.treasury/purchase/pdf/Chapter25List.pdf>

Bidders **must** review this list prior to completing the below certification. **Failure to complete the certification and return it with the bid will render a bidder's proposal non-responsive and the bid will be rejected.** If the Director finds a person or entity to be in violation of law, s/he shall take action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the party.

PLEASE CHECK THE APPROPRIATE BOX:

- ☐ I certify, pursuant to N.J.S.A. 52:32-55, that neither the bidder listed above nor any of the bidder's parents, subsidiaries, or affiliates is listed on the N.J. Department of the Treasury's list of entities determined to be engaged in prohibited activities in Iran pursuant to the statute and the Chapter 25 List. I further certify that I am the person listed above, or I am an officer or representative of the entity listed above and am authorized to make this certification on its behalf. I will skip Part 2 and sign and complete the Certification below.

OR

- ☐ I am unable to certify as above because the bidder and/or one or more of its parents, subsidiaries, or affiliates is listed on the Department's Chapter 25 List. I will provide a detailed, accurate and precise description of the activities in Part 2 below and sign and complete the Certification below. Failure to provide such will result in the proposal being rendered as non-responsive and appropriate penalties, fines and/or sanctions will be assessed as provided by law.

**PART 2: PLEASE PROVIDE FURTHER INFORMATION RELATED TO INVESTMENT
ACTIVITIES IN IRAN - add additional sheets if necessary.**

You must provide a detailed, accurate and precise description of the activities of the bidding person/entity, or one of its parents, subsidiaries or affiliates, engaging in the investment activities in Iran outlined above by completing below:

Name of Entity: _____; Relationship to Bidder: _____

Description of
Activities: _____

Duration of Engagement: _____ Anticipated Cessation Date: _____

Bidder/Offeror Contact Name: _____; Contact Phone: _____

Sign Certification - next page

EXHIBIT S - continued

DISCLOSURE OF INVESTMENT ACTIVITIES IN IRAN

BIDDER: _____

Certification:

I, being duly sworn upon my oath, hereby represent that the foregoing information and any attachments thereto to the best of my knowledge are true and complete. I acknowledge that I am authorized to execute this certification on behalf of the bidder, that the County of Camden is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the completion of any contracts with the County to notify the County in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the County of Camden, permitting the County to declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print): _____

Signature: _____

Title: _____

Date: _____

EXHIBIT T

NEW JERSEY ANTI-DISCRIMINATION PROVISIONS N.J.S.A. 10:2-1 et seq.

Pursuant to N.J.S.A. 10:2-1, if awarded a contract, the contractor agrees that:

- a. In the hiring of persons for the performance of work under this contract or any subcontract hereunder, or for the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under this contract, no contractor, nor any person acting on behalf of such contractor or subcontractor, shall, by reason of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex, discriminate against any person who is qualified and available to perform the work to which the employment relates;
- b. No contractor, subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee engaged in the performance of work under this contract or any subcontract hereunder, or engaged in the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under such contract, on account of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex;
- c. There may be deducted from the amount payable to the contractor by the contracting public agency, under this contract, a penalty of \$50.00 for each person for each calendar day during which such person is discriminated against or intimidated in violation of the provisions of the contract; and
- d. This contract may be canceled or terminated by the contracting public agency, and all money due or to become due hereunder may be forfeited, for any violation of this section of the contract occurring after notice to the contractor from the contracting public agency of any prior violation of this section of the contract.

No provision in this section shall be construed to prevent a board of education from designating that a contract, subcontract or other means of procurement of goods, services, equipment or construction shall be awarded to a small business enterprise, minority business enterprise or a women's business enterprise pursuant to P.L.1985, c.490 (C.18A:18A-51 et seq.).

BIDDERS PROPOSAL

PROJECT IDENTIFICATION:

CHALLENGE GROVE PARK PAVILION IMPROVEMENTS

THIS BID IS SUBMITTED TO:

County of Camden
520 Market Street
17th Floor, Courthouse
Camden, New Jersey 08102-1375

BIDDER'S NAME _____

CONTRACT TIME: 180 CALENDAR DAYS

1. The signer of this Proposal as Bidder declares:
 - a. That he has received and examined the Bid Documents, including the Invitation to Bid, Camden County Bid Requirements, Instruction to Bidders, Bidders Proposal, Enumeration of Contract Documents, Special Provisions, Specifications, Appendices, Contract Plans, and Addenda, if any.
 - b. That he has examined the site of the work.
2. The Bidder agrees that the work will be fully completed for this Contract within **180 CALENDAR DAYS** from the date specified in the Notice-to-Proceed.
3. The Bidder understands that Camden County reserves the right to reject any or all Bids, or to waive any informality or technicality of any Bid, in the interest of the County.
4. It is understood that the Total Price for the entire contract stated by the undersigned in the Schedule is based on the estimated quantities and will control in the awarding of the contract. It is further understood that the quantities stated in this Schedule of Prices for the various items are estimated only and may be increased or decreased by the owner and or its representatives only. Payment will be made only for the actual quantity of authorized work done under each scheduled item.
5. If this Bid shall be accepted by Camden County, and the Bidder shall fail to execute the Contract as aforesaid, then Camden County shall be entitled to recover from the Bidder the Bid Bond, and any other damages specified in the Contract and bid Documents.
6. **LIQUIDATED DAMAGES:** If the Contractor fails to complete the project and each and every part and appurtenance thereof fully, entirely and in conformity with the provisions of the contract within the times stated in the contract, or within such further time as may have been granted in accordance with the provisions of the contract, then the County may withhold permanently from the Contract's total compensation the appropriate amount of \$500 for each and every day that the work remains incomplete, which said amount shall not be considered a penalty, but liquidated damages for the loss, inconvenience and extra expense to the County by such delays.
7. It is recognized that no two pieces of equipment and no two products are engineered or designed exactly the same. Trade names, brand names and models specified herein are provided to establish a minimum standard of quality acceptable to the County for this bid. Substitute brands, makes and models shall be considered and reviewed on the basis of their ability to perform the specified tasks or provide the same quality of goods as specified in the County's bid. This is known as an "Equivalent". If the bidder seeks to provide an Equivalent product or good, the bidder shall with its bid submission include specifications or cut sheets for such proposed Equivalent

BIDDERS PROPOSAL

product or good. The County's Architect/Engineer for the bid shall review the submission provided by the bidder to determine whether the product or good is an Equivalent to the bid specification. The County's Architect/Engineer for the bid shall have the final decision on whether a bidder's submitted product specifications are an Equivalent to the named product(s) or good(s) in this bid.

8. Should any requirements in the contract documents be found to conflict with the County's general bid boilerplate (the ITB pages) the general bid boilerplate provisions and language shall prevail.
9. **SCOPE OF ALLOWANCE FOR WORK NOT SPECIFIED:**
 - a. The contractor shall make an allowance in his bid for any modifications or additions associated with construction of the project including any incidental or additional material, services or appurtenances not specifically described in the specifications but required to satisfactorily complete the project. All work must be ordered by the Engineer to qualify for payment. This item is intended to be utilized to compensate the contractor for any unknown items of work.
 - b. The contractor will be paid from the allowance based on a mutually agreeable price between the contractor and the Engineer prior to commencing work not specified. To qualify for payment, work must be ordered by the Engineer in writing.

The undersigned (name of bidder) _____, after complete examination of the plans, specifications, addenda, form of contract, and bond hereby proposes to furnish all labor and materials, together with all incidental thereto, to complete the project in accordance with drawings, specifications and addenda prepared by CME Associates, One Market Street, Suite 1F Camden, New Jersey 08102 which are understood as being a part of this Proposal.

NOTE: ALL AMOUNTS SHALL BE SHOWN IN BOTH WORDS AND FIGURES. In case of a discrepancy, the amount shown in words shall govern.

Bidder's Proposal

<i>Item No.</i>	<i>Description</i>	<i>Bid Quantity</i>	<i>Unit</i>	<i>Unit Price (\$)</i>	<i>Amount (\$)</i>
1	Clearing and Preparation of Challenge Grove Park (MAXIMUM BID PRICE FOR THIS ITEM IS \$50,000.00)	1	LS		
2	Pavilion Improvements, including excavation, earthwork and grading, construction of in-kind pavilion structure, connection of utility services, installation of concrete walkway and patio (283 SY) to service building, site protection and restoration and all other materials and services for a complete and fully functional building	1	LS		
3	Custom 19' Wide Gazebo Structure, including concrete foundations and mounting	1	UN		
4	Concrete Paver Patio and Walkway, including compass rose inlay and sub-base	80	SY		
5	Cast Stone Concrete Block Wall, 12" High, including sub-base	100	LF		
6	6' Long Decorative Bench, including concrete pad and permanent anchoring	4	UN		
7	6' Long Decorative Backless Bench, including concrete pad and permanent anchoring	2	UN		
8	Pavilion Mounted Luminaire, including all rigid conduit, wire, hand holes, and connections for a fully functioning system	1	UN		
9	Topsoil, Fertilize, Lime, and Hydroseed all Disturbed Areas of Challenge Grove Park	1	LS		

BIDDER'S PROPOSAL

Furnish all Labor and materials as required to complete the project in accordance with the contract documents.

TOTAL BASE BID (ITEMS 1 THROUGH 9):

GENERAL CONSTRUCTION ALLOWANCE: \$10,000.00

TOTAL BASE BID INCLUDING ALLOWANCE:

.....
(Written)

.....
(\$ Figures)

RESPECTFULLY SUBMITTED,

DATE:

SEAL IF BID IS CORPORATION

BY:
Name of Firm

.....
Print Name

Affix
Corporate
Seal Here

.....
Signature

.....
Title

.....
Business Address

.....

.....

.....
Phone

.....
Email

ENUMERATION OF PLANS AND SPECIFICATIONS

The following are plans (also called drawings) which form part of this contract:

GENERAL TITLE

COUNTY OF CAMDEN, NEW JERSEY

CHALLENGE GROVE PARK PAVILION IMPROVEMENTS

Contract No. CCM00208.01

Camden County Bid No. A37-20

FILE NUMBER CCM00208.01

<u>SHEET NUMBER</u>	<u>SPECIFIC TITLE</u>
1	COVER & INDEX SHEET
2	CHALLENGE GROVE PARK PAVILION SITE PLAN
3	CHALLENGE GROVE PARK GAZEBO SITE PLAN
4	CONSTRUCTION DETAILS

THE FOLLOWING ARCHITECTURAL DRAWINGS ARE PROVIDED AS A SEPARATE SET

C-1	COVER SHEET
A-1	FLOOR PLANS, ROOF PLAN, REFLECTED CEILING PLAN, BUILDING ELEVATIONS AND BUILDING SECTIONS
A-2	WALL SECTIONS AND DETAILS
M0.1	MECHANICAL GENERAL INFORMATION
M1.1	MECHANICAL FLOOR PLAN
M2.1	MECHANICAL DETAILS AND SCHEDULES
P0.1	PLUMBING GENERAL INFORMATION
P1.1	PLUMBING FLOOR PLAN
E0.1	ELECTRICAL GENERAL INFORMATION
E1.1	ELECTRICAL FLOOR PLAN

TECHNICAL SPECIFICATIONS

CONSIST OF DIVISIONS	1 -	GENERAL REQUIREMENTS
	2 -	SITE WORK
	16 -	ELECTRICAL
	APPENDIX -	ARCHITECTURAL PLANS AND SPECIFICATIONS

COUNTY OF CAMDEN
NEW JERSEY

CHALLENGE GROVE PARK PAVILION IMPROVEMENTS

SPECIAL PROVISIONS

1. **All Requests for Information (RFI) must be submitted via email to Jim Winckowski, at JWinckowski@cmeusa1.com by Wednesday, July 29, 2020 at 12:00 PM.**

2. Job Site Security

The contractor is responsible to secure the job site including all equipment, materials and work product until such time that the project is completed and accepted by the Owner. No additional payment will be made to reimburse the contractor for costs associated with vandalism or theft of project equipment, materials or work product.

3. Existing Utilities

The contractor shall coordinate all work with the utility companies in the areas of construction. Information regarding existing utilities has been collected from various sources and the contractor is advised that underground object locations, elevations, or types are not warranted to be approximately correct. Nor can they be assumed to be the only subsurface objects, proposed or existing, which may be encountered during the excavation of the work. The contractor shall make all necessary investigations prior to bidding to satisfy himself as to the existing conditions.

4. Camden County Soil Conservation District Certification

The contractor is advised that this project does not meet the requirements necessary for submission to Camden County Soil Conservation District, however, the contractor shall comply with all standard Soil Erosion and Sediment Control Guidelines for New Jersey and as directed by the Engineer.

No separate payment will be made for soil erosion and sediment control measures, including all compaction testing, and/or performing compaction mitigation (tilling or discing). Payment for general soil erosion and sediment control measures to be included under bid item, 'Clearing and Preparation of Site'. If it is determined that compaction mitigation is required, no separate payment will be made.

5. Contractor's Progress Schedule and Schedule of Values

The contractor shall submit a proposed schedule of operation for the project prior to commencement of construction that clearly indicates how he proposes to conduct the work to bring about the completion of the projects within the Contract Time.

The contractor shall also provide a Schedule of Values detailing an itemized breakdown of all lump sum bid items for progress payment purposes. Said Schedule shall be submitted to and approved by the Engineer prior to the first request for payment submittal.

6. Construction Contingencies

The contractor's attention is specifically directed to the fact that various items and extra quantities have been included in the bid form for contingency purposes due to the nature of the work to be performed in conjunction with this project.

Accordingly, the contractor is hereby advised prior to submitting his bid that he shall take into account the fact that contingencies have been included in the items and that portions of certain

COUNTY OF CAMDEN
NEW JERSEY

CHALLENGE GROVE PARK PAVILION IMPROVEMENTS

SPECIAL PROVISIONS

items or entire items may not be utilized by the Owner, depending upon the conditions encountered during the work.

To that end, the initial contract award amount may be significantly higher than the final contract amount, depending upon the actual conditions encountered.

The contractor must satisfy himself by personal examination of location of the proposed work and surroundings thereof, and by such other means that he prefers, and shall not at any time after submission of the bid, dispute the original estimate of the work, nor assert that there was any misunderstanding in regard to the contingencies included in the quantities.

7. Asbestos Cement Pipe Removal/Disposal

When disturbing, removing and/or disposing of asbestos cement pipe, the contractor shall comply with all applicable federal, state and local requirements, including, but not limited to: current USEPA regulations (NESHAP 40 CFR 61 Subpart M); OSHA regulations (29 CFR 192658); the current New Jersey Asbestos Hazard Abatement Subcode (NJAC 5:23-8); the current NJDEPE regulations (NJAC 7:26-1 et. seq.); and notification regulations (NJAC 5:23-8.6, 40 CFR 61 Subpart M, and NJAC 7:26-2:12).

8. Permits & Fees

The contractor shall be responsible for all fees and obtaining all permits necessary for construction in accordance with existing local, county and state regulations and any other agency having jurisdiction in these matters.

The Contractor must obtain and pay for all applicable City building permits if applicable. The Notice to Proceed will not be issued until all necessary permits are in hand. Contractor must abide by all conditions and regulations of said permits.

9. Special Site Conditions

The contractor is advised that construction of all the major components of this contract take place on public park property. Additionally, site access is adjacent to a residential development, the contractor shall take extreme care when traveling along these roadways. In addition, special care shall be exercised to provide adequate safety to the general public, residents and their property at all times.

Specific details and scheduling of any facility closures due to the proposed improvements shall be coordinated with the Engineer and the Owner. Work on Sundays and Holidays is prohibited, work on Saturdays and after 5 pm on weekdays must be authorized by the Owner and Engineer.

The contractor shall provide, install and maintain (on a daily basis) fencing, barricades or other suitable materials to protect all active construction areas, newly installed surfaces and construction equipment/supplies from unauthorized access and/or damage during the contract time.

Methods and materials for said protection measures shall be approved by, and coordinated with, the Owner and Engineer.

Separate payment for said protection measures will not be made. Cost of same shall be included in all contract items requiring protection.

COUNTY OF CAMDEN
NEW JERSEY

CHALLENGE GROVE PARK PAVILION IMPROVEMENTS

SPECIAL PROVISIONS

10. Special Attention to Existing Conditions

It is recommended that the bidder visit the site during preparation of bid to ensure full understanding of existing conditions.

The contractor must satisfy himself by personal examination of location of the proposed work and surroundings thereof, and by such other means that he prefers, and shall not at any time after submission of the bid, dispute the original estimate of the work, nor assert that there was any misunderstanding in regard to the project scope.

11. Accessibility of Recreational Facilities

Please note that per N.J.A.C. 5:23-7.15 all recreational facilities in New Jersey must be accessible to people with physical disabilities. An accessible route of travel is required at and between all facilities, support facilities, and access points with surfaces permitting independent wheelchair passage. The *New Jersey Barrier Free Subcode: Recreation Section*, available from the Department of Community Affairs Division of Codes and Standards ((609) 984-7609), provides details on making the following recreation facilities accessible: routes of travel, pools, swimming and skating areas, boating areas, fishing areas, court games, ice rinks and roller rinks, playing fields, golf facilities, skiing facilities, trails, camping sites, park and playground equipment, and equestrian facilities.

12. Conflicts in Contract Documents and Specifications

Should any requirements in the contract documents be found to conflict with the owner's general bid boilerplate the general bid boilerplate shall prevail.

13. Specified Products and Materials

It is recognized that no two pieces of equipment and no two products are engineered or designed exactly the same. Trade names, brand names and models specified herein are provided to establish a minimum standard of quality acceptable to the County for this bid. Substitute brands, makes and models shall be considered and reviewed on the basis of their ability to perform the specified tasks or provide the same quality of goods as specified in the County's bid. This is known as an "Equivalent".

If the bidder seeks to provide an Equivalent product or good, the bidder shall with its bid submission include specifications or cut sheets for such proposed Equivalent product or good. The County's Architect/Engineer for the bid shall review the submission provided by the bidder to determine whether the product or good is an Equivalent to the bid specification. The County's Architect/Engineer for the bid shall have the final decision on whether a bidder's submitted product specifications are an Equivalent to the named product(s) or good(s) in this bid.

14. Maintenance Bond

The contractor is advised a two (2) year maintenance bond in the amount of fifteen (15) percent of the final contract amount is required for this project. The maintenance bond period will begin once the project has been accepted by the County and the final payment has been made. At that time, the full two (2) year maintenance bond period will begin.

SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

<u>1-0.1</u>	<u>TABLE OF CONTENTS</u>
1-2.6	PROGRESS SCHEDULE
1-4.1	BOUNDARIES OF THE WORK
1-4.4	LINES AND GRADES
1-6.3	WORK IN BAD WEATHER
1-6.4.1	CONTRACTOR'S OFFICE
1-6.4.2	WATER AND ELECTRICITY
1-6.4.3	HEATING
1-6.4.4	TRAFFIC PROTECTION AND PARKING OF CARS
1-6.4.5	SURFACE DRAINAGE
1-6.4.6	ENGINEER'S FIELD OFFICE
1-6.5	DOMESTIC MATERIAL
1-6.17.1	SANITARY-REGULATIONS
1-6.17.2	FINAL CLEANING
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1-6.20.4	ACCIDENT PREVENTION AND FIRST AID
1-6.20.4.1	CONTRACTOR'S SIGNS
1-6.23.1	WORKING DRAWINGS
1-13.2	INSPECTION
1-13.3	NOTICE OF INSPECTION TO BE GIVEN BY THE CONTRACTOR
1-13.10	STOPPING WORK
1-18.1	PROJECT PHOTOGRAPHS
1-19.1	ABBREVIATIONS
1-20	EXISTING UTILITIES

SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

1-2.6 PROGRESS SCHEDULE.

Within ten (10) days after the award of the Contract, the Contractor shall submit in writing a proposed program of operation, showing clearly how he proposes to conduct the work so as to bring about the completion of his work within the time limit specified. This program shall outline the proposed sequence of operations, the rates of progress and the dates when each part of his work will be completed. The work under this Contract shall, in general, be so scheduled that the work will be coordinated with work by others on adjacent contracts, if any.

The Contractor shall accompany this schedule with a list of delivery dates for materials and equipment.

This plan of operation may be adjusted and revised as the work progresses, but such changes must have at all times the approval of the Engineer.

In any event it shall be the purpose of the progress schedule to guide the course of the work, and strict adherence to it will be demanded by the Engineer.

If all or part of the work of the Contract will be substantially delayed by the extremes of winter weather, the Contractor shall anticipate such delays, shall prepare his progress schedule in a manner that will minimize the overall effect of such anticipated weather delays, and shall periodically update said schedule in accordance with actual weather delays experienced to that date and anticipated for any subsequent period.

1-4.1 BOUNDARIES OF THE WORK.

The Contractor shall obtain from the Owner all information regarding the areas that may be available for his operations and to what extent and for what period of time he may occupy them.

He shall also obtain from the Municipality, County and/or NJDOT required provisions to provide and maintain traffic along Municipal or County Roads and/or State or Federal Highways approaching or within the site or sites of his work, and he shall comply with the requirements of these public agencies.

1-4.4 LINES AND GRADES.

All work under this Contract shall be constructed in accordance with the lines and grades shown on the Plans or as given by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

Primary reference points for the laying out of the work shall be provided by the Owner.

Lines and grades will be set by a N.J. Licensed Land Surveyor employed by, or retained by the Contractor as the work progresses and will be located to cause as little inconvenience to the prosecution of the work as possible.

The Contractor shall so place excavation and other materials so as to cause no inconvenience in the use of the lines and grades established. He shall remove any obstructions placed by him contrary to this provision.

The Contractor shall furnish and maintain at his own expense, stakes, and other such materials, and give such assistance, including qualified helpers, as may be required for setting line and checking grade marks.

The Contractor shall provide grade sheets at least two (2) working days in advance of the time same will be needed for review, and shall keep the Engineer informed of daily work schedules so that all necessary measurements may be made for record and payment with a minimum of inconvenience to the Engineer or of delay to the Contractor.

It is the intention not to delay the work for the giving of lines and grades, but, when necessary, working operations shall be suspended for such reasonable times as Contractor's surveyor may require for this purpose.

The Contractor shall safeguard all points, stakes, grade marks, monuments and bench marks made or established on the work, re-established them and bear the entire expense of rectifying work improperly installed due to not maintaining or protecting or for removing without authorization such established points, stakes, and

marks. Replacement of disturbed or destroyed Principal reference points shall be completed by a N.J. Licensed Land Surveyor, acceptable to the Owner and Engineer, and at the Contractor's expense.

1-6.3 WORK IN BAD WEATHER.

During freezing, stormy or inclement weather, the Contractor shall provide heat, shelter, and other facilities as directed and necessary to maintain the progress schedule and all work shall be done in a manner to secure first class construction throughout.

1-6.4.1 CONTRACTOR'S OFFICE

Unless specifically waived in the Proposal, the Contractor shall erect, furnish and maintain a field office, with a telephone at the site during the entire period of construction. He or an authorized agent shall be present at said office at all times or at definite times while his work is in progress. Readily accessible copies of both the Contract Documents and the latest approved working drawings shall be kept at said field office. This office shall be suitably heated and shall be equipped with proper sanitary facilities.

1-6.4.2 WATER AND ELECTRICITY.

The Contractor shall unless specified, provide the necessary water supply at his own expense and shall pay for all water used.

The Contractor shall unless otherwise specified, provide, at his own expense, adequate temporary lighting and electrical power facilities if required for the proper prosecution and inspection of the work. If, in the opinion of the Engineer, these facilities are inadequate, the Contractor shall provide facilities which are satisfactory to the Engineer.

1-6.4.3 HEATING

The Contractor shall provide temporary heat, whenever required on account of work being carried on during cold weather and to prevent freezing of water pipes and other damage to the work. Heat shall be furnished when and as directed and at the Contractor's own expense.

1-6.4.4 TRAFFIC PROTECTION AND PARKING OF CARS

The Contractor shall protect all traffic and parked cars, when lawfully parked, and shall see to it that the cars belonging to his workmen are parked in areas permitted by the municipal authorities.

He shall take particular care to provide access to adjacent property, both for ordinary traffic and emergency vehicles. Access to fire hydrants shall be kept clear at all times. The Contractor will be required to prevent the formation and flying of dust to the satisfaction of the Engineer by the use of water or chemicals.

Unless expressly authorized in advance and in writing, the Contractor shall maintain a minimum of one lane of traffic through the project area controlled by competent Flagmen as necessary. IMMEDIATE clearance through the project area shall be furnished for Fire/Rescue/Police Vehicles and School Buses. If necessary, work shall be temporarily suspended to permit the immediate passage of Fire/Rescue/Police or other emergency vehicles and/or school buses.

Local and through traffic shall be maintained at all times unless the Owner approves a detour route for a duration of time.

Whenever it is necessary to maintain only a single line of traffic, the contractor shall furnish and employ sufficient competent traffic directors during the day and night to adequately guide and protect traffic.

The Contractor shall erect and maintain barricades, danger signals and warning signs at working sites, closed roads, intersections and other places of danger to traffic or to the completed work as directed and approved by the Engineer. Each barricade shall be provided with red flashing lights battery operated not more than five feet apart and not less than three lights shall be used.

Where specific detour routes or traffic protection signs and equipment are specified or required by the plans, the Contractor will provide same along with all other signage equipment and flagmen necessary to satisfactorily protect and safely coordinate traffic.

Vehicular and pedestrian traffic on streets shall be maintained and protected at all times, and all operations in or adjacent to streets, sidewalks, and walkways shall be conducted and controlled accordingly.

The Contractor shall, for the protection of the traveling public and his personnel, familiarize himself and adhere strictly to the requirements of these Specifications and to the requirements of Title 39, the Motor Vehicle Code of the State of New Jersey, wherever it shall pertain to necessary and required precautionary measures regarding the type of work being done.

The cost of protection of traffic as above described and in addition to uniformed traffic directors shall be as stated in the Division 2 Specifications and in the Proposal.

Uniformed Traffic Directors:

Uniformed Traffic Directors (law enforcement officers) from the jurisdiction(s) affected by this project may be required by the terms of the Proposal (Section C) for this project. If required by the terms of the Proposal, and if the contracting unit does not elect to provide for the direct payment of uniformed law enforcement officers and any additional costs directly associated with the provision of those officers, a line item allowance (bid item) has been established with a dollar amount based on a good faith effort on the part of the contracting unit to reasonably estimate the total cost (as it relates to Uniformed Traffic Directors). The unit of measure for said line item allowance is man-hours and said unit shall include the cost of traffic control personnel, vehicles, equipment, administrative or any other costs associated with additional traffic control requirements required by the contracting unit, or any other public entity affected by the project, above and beyond the bidders traffic control personnel, vehicles, equipment and administrative costs. The line item unit price used in the proposal is the price per man-hour established by the contracting unit for these services and is the same unit price to be used by the contracting unit when billing the Contractor. No additional compensation over and above the established unit price multiplied by the approved number of man-hours worked will be due the Contractor.

For this contract, the estimated number of man-hours listed in the proposal is based on one uniformed officer at any one work area. The Contractor shall provide any additional traffic direction personnel/flagmen to assist if and where required due to the nature of the work and extent of the work area.

The contracting unit shall not be responsible for additional traffic control costs beyond the number of working days specified in the construction contract in accordance with Section 17 of P.L. 1971, c. 198 (C.40A:11-17), when such a delay is caused by the contractor and liquidated damages have been assessed.

1-6.4.5 SURFACE DRAINAGE

The Contractor shall furnish all necessary equipment, shall take all necessary precautions, and shall assume the entire cost of handling any surface drainage occurring during the construction of the work. The manner of providing for these flows shall meet the approval of the Engineer and the entire cost of said work shall be deemed included in the unit or lump sum prices for the various items of work to be done under the Contract.

1-6.4.6 ENGINEER'S FIELD OFFICE.

If not waived by the terms of the proposal and contract agreement, the contractor shall furnish Engineer's Field Office, provide the necessary utilities for same, including heat, light, potable water, power, telephone, toilet facilities, janitorial supplies and services, and waste disposal, and shall pay all costs associated with same and fully complying with the following particulars. No separate payment will be made for these facilities and all costs related to same are to be included in the respective bid prices in the Proposal.

1-6.5 DOMESTIC MATERIAL

The contractor during the course of this contract agrees to use, supply or deliver only such manufactured articles, materials and supplies as have been manufactured in the United States substantially from articles, materials and supplies mined, produced or manufactured in the United States, wherever available.

1-6.17.1 SANITARY-REGULATIONS.

Toilet accommodations properly secluded from observation shall be erected and maintained by the Contractor, in such a manner and in such locations as approved by the Board of Health, and their use shall be strictly enforced.

The building of shanties or other structures for housing the men, tools, machinery or supplies, will be permitted only at approved places and the sanitary conditions of the ground in and at such shanties or other structures must be at all times maintained in a satisfactory manner.

1-6.17.2 FINAL CLEANING.

At the conclusion of the work, all erection plant, tools, temporary structures, and materials belonging to the Contractor shall be promptly taken away, and he shall remove and promptly dispose of all water, dirt, rubbish, or any other foreign substances.

The Contract shall thoroughly clean all equipment and materials installed by him and shall deliver over such materials and equipment undamaged in a bright, clean, polished, and new appearing condition.

1-6.20.2 PROTECTION OF WORK UNTIL COMPLETION.

During performance and up to the date of final acceptance, the Contractor shall be under an absolute obligation to protect the finished and unfinished work against any damage, loss or injury. The Contractor shall take proper precautions to protect the finished work from loss or damage, pending completion and the acceptance of all the work included in the entire Contract, provided that such precaution shall not relieve the Contractor from any and all liability and responsibility for loss or damage to the work occurring before acceptance by the Owner. Such loss or damage shall be at the risk of and borne by the Contractor, whether arising from acts or omissions of the Contractor or others, or from floods, storms, high tides, or otherwise. In the event of any such loss or damage, the contractor shall forthwith repair, replace and make good the work without additional compensation or extension of time therefore, except as may be otherwise provided herein.

These provisions shall not be deemed to create any new right of action in favor of third parties against the Contractor or Owner.

The contractor shall provide for the removal of all dirt spilled from the trucks on existing pavements over which it is hauled, or which is washed or otherwise deposited thereon by reason of his work, whenever, in the opinion of the Engineer, the accumulation is sufficient to cause the formation of mud, interfere with drainage or to create a traffic hazard.

Costs incidental to the maintenance of existing roadways as herein described, shall not be paid for under any specific item but shall be included in the unit prices bid for other items scheduled in the Proposal. In the event that the contractor fails to maintain safe traffic conditions and job conditions, the Municipality may after failure of the contractor to provide safe traffic conditions, hire guards or take such precautions to safeguard traffic, and the cost of same shall be deducted from payment due the contractor.

1-6.20.3.1 CARE OF PUBLIC AND PRIVATE PROPERTY

The Contractor shall preserve from damage all property along the line of the work, or which is in the vicinity of or is in any way affected by the work, the removal or destruction of which is not called for by the Plans. This applies to the public utilities, railroads, trees, monuments, fences, pipe and underground structures, public streets (except natural wear and tear of streets resulting from legitimate use thereof by the Contractor), and wherever such property is damaged due to the activities of the Contractor, it shall be immediately restored to a first class condition by the Contractor and at his own expense.

In case of failure on the part of the Contractor to restore such property, or make good such damage or injury, the Owner may, upon forty-eight hours notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any moneys due or which may become due the Contractor under this Contract.

Nothing in this clause shall prevent the Contractor from receiving proper compensation for his costs incurred because of the removal or replacement of any public or private property, when this is made necessary by alteration of grade or alignment, or any such work authorized by the Owner, provided that such property has not been damaged through fault of the Contractor, his employees, or agents.

1-6.20.3.2 PROTECTION AND REPLACEMENT OF SUBSURFACE STRUCTURES AND UTILITIES -

The plans may show certain but not all subsurface structures known to exist in the working area. The Contractor shall particularly note that the indicated locations of subsurface water, gas, electric, telephone, sewerage and drainage systems in the area may be quite different from their actual locations and that there may be some subsurface structure or utility encountered that is not shown on the plans. Therefore, it shall be his responsibility to proceed with caution in executing the work, so as to prevent undue interruptions of utility service to property owners and damage to structures or utilities, or injury to workmen or others.

The Contractor will be held responsible FOR ALL DAMAGES to all utilities or other underground or surface structures whether or not they are shown on the Contract Drawings, and he shall pay all costs for protecting them or for repairing and/or replacing them IF THEY ARE DAMAGED AS A RESULT OF OPERATIONS UNDER THIS CONTRACT.

In the event that UNDERGROUND STRUCTURE OR UTILITIES are disclosed by the Contractor's operations THAT OCCUPY THE SAME SPACE AS REQUIRED BY INSTALLATIONS UNDER THIS CONTRACT, the Contractor shall notify the Engineer and await his orders concerning the removal and replacement of said structures or utilities. The procedures regarding compensation in this event will be as follows:

- a. Where it develops that the utility company will remove and relocate the structure or utility at its own expense and with its own forces, no compensation therefore will be due the Contractor.
- b. Where the utility company will not assume the expense but exercises its right to perform the work with its own forces, the Contractor shall pay the cost incurred upon being presented with a bill for the same, and will in turn be reimbursed by the Owner for the amount paid thereon plus five percent (5%).
- c. Where the Contractor has to perform the work of removal and relocation with his own forces, he shall be reimbursed as set forth under Article G 10.1.1, entitled, "Extra Work - Increased Compensation". This provision shall likewise apply to instances under (a) and (b) above, where the contractor's forces or equipment are required for only a portion of the work.

Wherever gas mains, petro-chemical mains, electrical or heating ducts, electric, telephone, or telegraph poles or ducts, private or municipal water mains are encountered and service may be interrupted, the Contractor shall keep the Owner utility company or department fully informed in advance of any changes he desires to make. The Contractor shall cooperate with the utility company or department in the removal, relocation, and replacement of such structures, so as to avoid all unnecessary interruption of service. He shall arrange with the owners of the utilities for this work to be done.

If, in the opinion of the Engineer, it is necessary to install temporary lines, to prevent interruptions in utility service to residents, the Contractor shall install or have installed the temporary lines necessary to provide service. He shall maintain and protect such lines during the course of the work and shall remove them when permanent connections have been made unless otherwise directed by the Engineer. The costs therefore shall be assumed by the Contractor in all cases excepting only where the structure or utility requiring such temporary replacement, occupies the same space as that needed for installations under this Contract, in which event the procedures for compensation listed under (a), (b) and (c) in this Article will be followed.

Such work shall be performed to the satisfaction of the Engineer.

Where the Owner's storm drains, sewer lines, or water mains are encountered and repair, replacement, or relocation is necessary before work can proceed, the Contractor shall carry out the work promptly as directed by the Engineer.

1-6.20.4 ACCIDENT PREVENTION AND FIRST AID

Precautions shall be exercised at all times for the protection of persons and property. The safety provisions and applicable laws, building and construction codes shall be observed. Machinery and equipment shall be guarded and all hazards eliminated in accordance with safety provisions of Construction Industry OSHA Safety and Health Standards (29CFR 1926/1910), including amendments and supplements to date, published by the U.S. Department of Labor, Occupational Safety and Health Administration, to the extent that such provisions are not in contravention of applicable law. The Contractor shall provide suitable barricades, red lights, "Danger" or "Caution" signs and watchmen at all places where the work constitutes in any way a hazard to the public, or workmen.

The Contractor shall keep upon the site, at each location where work is in progress, a completely equipped first-aid kit and shall provide ready access thereto at all times when men are employed on the work.

1-6.20.4.1 CONTRACTOR'S SIGNS

The Contractor shall erect and maintain safety signs, temporary barricades, temporary fences, and take all precautions to guard against all dangers and hazards, as are necessary in the opinion of the Engineer in the interest of the public health and safety.

Signs shall be of suitable size to be readily seen and shall be black letters on orange background. Barricades, drums and like items shall be standard orange and white striped. Warning and detour signs and barricades and other safety devices shall be reflectorized painted or lighted, and maintained.

1-6.23.1 WORKING DRAWINGS

The Contractor shall promptly prepare and submit layout, detail, and shop drawings for such parts of the work as specified hereafter under the specifications for materials, workmanship and Contract Items. These drawings will be known as "Working Drawings."

The drawings shall be numbered to coincide with the Division and article of the specifications related to same, and consecutively numbered for all individual drawings for a particular item or items related to the particular division and article and shall accurately and distinctly present the following:

- a. All work and erection dimensions.
- b. Arrangement and sectional views.
- c. Necessary details, including complete information or making connections between work under this Contract and work under other Contracts.
- d. Kinds of materials and finishes.
- e. Parts list and description thereof.

Each drawing shall be dated and shall contain the name of the project, contract number, Contract Item and paragraph number, names of equipment or materials, and the locations at which the equipment or materials are to be installed in the work. The Engineer may decline to consider any working drawing that does not contain complete data on the work and full information on related matters.

If the working drawings show departures from the Contract requirements, the Contractor shall make specific mention thereof in his letter of submittal and on the subject drawing or drawings. Otherwise, approval of such submittals shall not constitute approval of the departures. Approval of the drawings shall constitute approval of the subject matter thereof only and not of any structure, material equipment or apparatus shown or indicated. The approval of drawings will be general and shall not relieve the Contractor of responsibility for the accuracy of such drawings, nor for the proper fitting and construction of the work, nor for the furnishing of materials or work required by the Contract and not indicated on the drawings. No work called for by working drawings shall be done until the said drawings have been approved by the Engineer.

The procedure in seeking approval of working drawings shall be as follows:

- a. The contractor shall submit for approval two prints and one reproducible sepia copy, or six prints in the case of manufacturer's catalogue "cuts" and similar items, of each of the drawings to the Engineer. The submission of drawings shall be accomplished by letter of transmittal in duplicate, containing the name of the project, the name of the Contractor, the number of drawings, titles, and other requirements.
- b. When a drawing is satisfactory to the Engineer, it will be stamped "NO EXCEPTIONS TAKEN", be dated, and two copies thereof will be returned to the Contractor by letter.
- c. Should a drawing be unsatisfactory to the Engineer, he will stamp thereon "REVISE AND RESUBMIT", or "REJECTED", and will return one copy thereof to the contractor with the

necessary corrections and changes indicated. The Contractor must make such corrections and changes and again submit two prints and one reproducible sepia copy of the drawing for approval, within five (5) working days of the date of rejection.

The Contractor shall revise and resubmit the working drawings as required by the Engineer, until "NO EXCEPTIONS TAKEN" thereof is obtained.

1-13.2 INSPECTION.

During the progress of the work and up to the date of final acceptance, the Contractor shall, at all times afford the representatives of the Owner every reasonable, safe and proper facility for inspecting the work done or being done at the site. The inspection of any work shall not relieve the Contractor of any of his obligations to perform proper and satisfactory work as herein specified. Finished or unfinished work found not to be in strict accordance with the Contract shall be replaced as directed by the Engineer, even though such work may have been previously approved and payment made therefore.

Failure or neglect on the part of the Engineer to condemn or reject bad or inferior work or materials shall not be construed to imply an acceptance of such work or materials, if it becomes evident at any time prior to the final acceptance of the work by the Owner, neither shall it be construed as barring the Owner at any subsequent time, from the recovery of damages or of such a sum of money as may be needed to build anew any portion of the work in which fraud was practiced or improper materials hidden, or used, wherever found.

1-13.3 NOTICE OF INSPECTION TO BE GIVEN BY THE CONTRACTOR.

Certain items in the work will require special inspection by the Engineer and/or his inspectors. The Engineer will so specify these items to the Contractor during the course of the work; whereupon the Contractor, before proceeding with such specified items, shall give two working days written notice in advance to the Engineer, for the purpose of scheduling and providing such inspection service.

1-13.10 STOPPING WORK

The Engineer, acting as the Owner's representative, may stop, by written order, or a verbal order confirmed in writing within twenty-four hours, any work or any part of the work under the Contract if in his opinion the methods or materials employed are unsafe, improper or defective. No payment for downtime will be made. When work is so stopped, it shall not be resumed until the methods or conditions are revised to the satisfaction of the Engineer, which must be signified in writing. Work may also be stopped by the Engineer or required to be postponed for an adequate period of time if the work interferes with, or unduly interrupts the operation of existing utilities. The Contractor is required to fully inform himself as to the nature and location of existing utilities within the project area, all locations of actual or potential interference, and coordinate the activities of affected utilities regarding any necessary temporary or permanent relocations to minimize possible or actual delay to planned progress.

1-18.1 PROJECT PHOTOGRAPHS

IF REQUIRED BY THE TERMS OF THE PROPOSAL and Contract Agreement, only, the Contractor shall provide three sets of acceptable, unretouched 8"x10" glossy, cloth mounted 8-1/2"x11" format, properly identified Pre-construction, Progress, and Final Construction Project Photographs comprising not less than the total number of individual prints stipulated in the proposal, with the cost of same included in the various prices bid. All project photographs shall conform with the following particulars and be delivered as required hereinafter.

1-19.1 ABBREVIATIONS

Where any of the following abbreviations are used in the Specifications they shall have the meaning set forth opposite each.

ACI	American Concrete Institute
ASTM	American Society for Testing Materials
ASCE	American Society of Civil Engineers
AWWA	American Water Works Association
ASME	American Society of Mechanical Engineers
NBS	National Bureau of Standards
AIEE	American Institute of Electrical Engineers
AASHO	American Association of State Highway Officials

NEMA	National Electrical Manufacturers Association
NEC	National Electric Code, latest edition
AISC	American Institute of Steel Construction
ASA	American Standards Association
AWS	American Welding Standards

FEDERAL SPECIFICATIONS

Federal Specifications issued by the Federal Supply Service of the General Services Administration, Washington, D.C.

125 LB. AMERICAN STANDARD

American Standard (ASA B16.1-1948) for Cast Iron Pipe Flanges and Flanged Fittings, Class 125

USS GAUGE United States Standard Gauge

N.J.D.O.T.S.S. New Jersey Department of Transportation Standard Specifications, 2007 (as amended)

GPD	Gallons per day
MGD	Million gallons per day
GPM	Gallons per minute
CFS	Cubic feet per second

SPECIFICATION ABBREVIATIONS

Omission in wording. For brevity, some sentences are incomplete and such words and phrases as "the contractor shall", in conformity therewith", "shall be", "as noted on drawing", "according to the drawings", "a", "an", "the" and "all" which clutter up most specifications are sometimes omitted. They shall be supplied by the reader.

The contractor shall provide all items, articles, materials, operating methods lists, mentioned or scheduled on drawings or in specifications, including all labor, materials, equipment, incidentals necessary and required for their completion.

Approvals, etc., wherever the words "approved", "satisfactory", "direct", "submitted", "inspected" or similar words or phrases are used, it shall be assumed that the word "Engineer" or one of their representatives follows the verb as the object of the clause, such as "approved by the Engineer" and "submitted to the Engineer".

References to the Standard Specifications or manufacturer's installation directions shall mean to the latest edition thereof, as published prior to the date of the agreement unless otherwise indicated.

Terminology: Words which have well known technical or trade meanings are used herein in accordance with such recognized meanings.

1. "Acceptable", "equal to", "proper", and other qualifying terms imply the judgment by the Architect/Engineer.
2. "Approved", or "Approval" means any equipment, item or material approved by the Architect/Engineer.
3. "Approved equal" means any equipment, item or material approved by the Architect/Engineer as equivalent to the specified equipment, item or material.
4. "Concealed" means work which is not exposed to view when the project is complete.
5. "Exposed" means work which remains exposed to view when the project is complete.
6. "Delivery" means unloading and storing at the site.
7. "Furnish" means to supply and deliver to the job.

8. "Governmental" means all Municipal, County, State and Federal government agencies.
9. "Install" means complete erection and connection of work.
10. "Piping" includes piping and all fittings, valves, hangers and other accessories related to piping.
11. "Provide" means "furnish" and "install" as defined above.
12. Words in singular form shall include as many such devices as are required to complete the work.

1-20 EXISTING UTILITIES

Prior to the start of any excavation work, the contractor shall contact the various utility companies in order to obtain firsthand information of underground piping and conduits:

One recommended number to call for various private utilities is 1-800-272-1000.

S P E C I F I C A T I O N S

DIVISION 2 - SITE WORK

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SECTION 2A - CLEARING AND PREPARATION SITE

WORK INCLUDED

Clearing and preparation of site shall consist of removing all natural and artificial obstacles and material from the construction areas and such other areas as may be specified. The above work includes, if applicable, the removal and resetting of street and road signs, mailboxes, fences, guardrail, removal of trees, shrubs, stumps, roots, brush, and grubbing, and any other structures as directed by the Engineer.

Clearing and preparation of site shall also include provisions for mobilization, demobilization, and general site clean-up during all phases of work *and* at the conclusion of the job.

Clearing and preparation of site shall also include provisions for soil erosion and sediment control measures, if and where shown on the plans, and/or required by the governing Soil Conservation District.

Protection of trees to remain is to be in accordance with the details in the contract drawings. Any existing trees at or near the proposed edge of disturbance shall be evaluated and, at the discretion of the Engineer, either removed or protected and saved.

The work also includes the removal and disposal of existing pavilion structures of varied material and sizes, asphalt walkways, site amenities such as benches, picnic tables, landscaping, and other various appurtenances as shown on each the contract drawings. Restoration, including filling, grading, and topsoil to meet adjacent grade shall be included in this item.

Any salvageable materials, such as the benches and/or site amenities shall be held for the County to review prior to disposing. The Contractor shall carefully remove and save any existing dedication plaques located on benches or other amenities, for future use by the Owner.

Existing improvements, adjacent properties, utilities and other facilities and trees or landscaping that are not to be removed shall be protected from injury or damage resulting from the Contractor's operations. Areas within the contract limits shall be cleared of all vegetation such as trees, logs, stumps, roots, downed trees, brush, grass, weeds and all other objectionable material as directed by the Engineer. Removal of large trees as directed by the Engineer shall be under the direct supervision of a N.J. Licensed Tree Expert utilizing forestry/tree removal equipment appropriate for safe removal of trees and the protection of public and private properties and utilities.

When or where any direct or indirect damage or injury is done to public, or private property, by or on account of any act or omission, neglect or misconduct, on the part of the Contractor in the execution of the work, such property shall be restored by the Contractor at his expense, to a condition equal to or better than existing before such damage or injury was done, or the Contractor shall provide compensation for the damage or injury in such other manner as may be acceptable to the Owner and/or Engineer.

MEASUREMENT AND PAYMENT

Pay Item

Pay Unit

CLEARING AND PREPARATION OF CHALLENGE GROVE PARK
PARK

LUMP SUM

Compensation for Clearing and Preparation of Site including all labor, equipment and materials for the work described above shall be included in the lump sum price bid for Bid Item No. 1 as listed in the proposal form.

Compensation for labor and materials required for soil erosion and sediment control measures, if and where required, tree save measures, all pruning, tree and limb removal, field dressing, removal of dead vegetation, and disposal as required by the Engineer shall be included in the bid price for Clearing and

Preparation of Site.

A portion of the bid amount for Clearing and Preparation of Site based on the approved schedule of values will be retained until final clean-up, restoration, punch lists, and demobilization are complete.

Separate payment will not be made for the items associated with clearing and preparation of site for which individual pay items have not been provided in the contract. Costs for same shall be included in the Lump Sum price bid for clearing site, and/or the prices bid for all items requiring the same.

SECTION 2B - SOIL EROSION AND SEDIMENT CONTROL

WORK INCLUDED

"Soil Erosion and Sediment Control" shall include the furnishing of all materials, labor, and equipment necessary for implementing proper measures to reasonably control soil erosion from construction operations and prevent excessive flow of sediment from the construction site. Such work may include the installation of water diversion structures, diversion ditches and sediment basins, compaction testing, compaction mitigation, seeding and mulching, and sodden critical areas to provide temporary protection.

MATERIALS

Materials shall conform to the requirements of appropriate articles of "Standard for Soil Erosion and Sediment Control in New Jersey" as revised and adopted January 2014, revised July 2017, and the Standard Specification for Road and Bridge Construction of the New Jersey Department of Transportation, 2007 as added to and amended. Such standard specifications are made part of the specifications by this reference and will not be repeated herein. In case of conflict between the above-mentioned requirements, the standard requiring the higher in terms of quality of materials and workmanship shall prevail.

METHODS OF CONSTRUCTION

The work on soil erosion and sediment controls shall include, but not be limited to the following:

1. All soil erosion and sediment control practices on this project shall be constructed in accordance with the "Standards for Soil Erosion and Sediment Control in New Jersey", or as approved for this project.
2. The smallest practicable area of land shall be exposed at any one time during the project and wherever feasible, natural vegetation shall be retained and protected. Stripping of vegetation, grading or other soil disturbance shall be done in a manner which will minimize soil erosion.
3. A schedule of construction operations shall be submitted to the Engineer for his approval.
4. A 72-hour notice shall be given to the Engineer prior to the start of construction or grading. This notice can be verbal but must be followed by a written statement not less than forty-eight (48) hours prior to start-up.
5. All soil erosion and sediment control devices shall be in place prior to any major soil disturbance or installed and removed in their proper sequence to allow for further operations on the site.
6. All sediment control structures shall be checked and maintained on a regular basis and all basins shall be cleaned periodically when storage capacity is affected by siltation.
7. During construction, any additional control measures as deemed necessary to prevent erosion or control sediment beyond those measures shown on the approved plans shall be installed or employed at the direction of the Engineer.
8. After completion of construction, soil and sediment controls shall be left in place until all disturbed areas are stabilized.
9. Disturbed areas including roadway embankments shall be maintained in a rough graded condition and temporarily seeded and/or mulched until proper weather conditions exist for the establishment of permanent vegetative cover.
10. All areas disturbed by grading on which permanent or semi-permanent seeding or temporary seeding have not been made and all slopes with a grade steeper than 2:1 shall

be treated by mulching. The mulch shall be applied at a rate of 2 tons per acre or equivalent measure, according to State standards.

11. All areas disturbed by grading including soil stockpiles, which will not be used or constructed upon a period greater than thirty (30) days shall be temporarily seeded and protected as required.
12. All areas disturbed by grading which will not be constructed upon within six (6) months are to be stabilized with a permanent type seeding and fertilizing.
13. Prior to installation of required topsoil in open areas, all compaction testing, and/or compaction mitigation measures (tilling or discing) to the subsoils, shall be completed, as set forth in the "Standards for Soil Erosion and Sediment Control in New Jersey", specifically the 'Standards for Topsoiling' and the 'Standards for Land Grading'. All compaction testing shall be completed in the presence of the Engineer.
14. All disturbed areas shall be topsoiled, limed and fertilized prior to both temporary and permanent seeding in conformance with charts and tables as set forth in the "Standards for Soil Erosion and Sediment Control in New Jersey".
15. Hay bales shall be deemed unacceptable filter material in areas greater than one-half (1/2) acre.
16. Access and haul roads shall be protected with stone access strips and coarse stone filters in appropriate locations.
17. Fording of streams shall be kept to a minimum and where frequent crossings are contemplated, temporary bridges or culverts shall be constructed.
18. Storm drainage inlets are to be either capped or protected by temporary filter devices to prevent the entry of sediment carried by run-off water until vegetation and/or paving is established as planned.
19. Wherever well points, pumps or other dewatering methods are used, care shall be taken to provide for the elimination of said dewatering.
20. All drainage swales shall be parabolic in shape unless otherwise noted and shall conform to SCS design and standards.
21. Drainage swales and other structures shall be located in the field so as to retain as much of the original vegetation as possible, especially large trees.
22. Soils having a pH of 4 or less or containing iron sulfide shall be covered with a minimum of 12 inches of soil having a pH of 5 or more before seed bed preparation. The added soil shall be limed as above.
23. Roadways shall be swept at the end of each working day by the Contractor. When deemed necessary by the Engineer, the Contractor shall have the roadways swept by a mechanical sweeper. Same shall be provided at no additional cost to the Owner.

MEASUREMENT AND PAYMENT

Separate payment for soil erosion and sediment control, if and where required, including all compaction testing, and/or compaction mitigation (tilling or discing) measures will not be made. Payment for Soil Erosion and Sediment Control, including all work and materials as detailed above including the removal of such measures at completion of the construction project or at such time when all disturbed areas are stabilized, shall be included in the price bid for items requiring same.

SECTION 2C - ENVIRONMENTAL PROTECTION MEASURES

WORK INCLUDED

The Contractor shall install, perform and maintain all environmental protection measures as detailed herein and as shown on the drawings. This section shall apply to all areas of work requiring same and in cases of conflicts with other sections, this section shall govern.

SPILL PREVENTION, REPORTING AND CLEAN UP

The Contractor shall take precautions to prevent hazardous materials spills. Should a spill occur, the Contractor shall immediately inform the Owner and his Engineer, and shall at Contractor's cost make such reports and complete such clean-up efforts as are required by Federal, State and local regulations. In the event of a spill, the Engineer will call the New Jersey Environmental Action Hotline at (609) 292-7172.

The Contractor shall supply and have on-site at all times, a supply of absorbent booms and other approved materials to isolate and contain possible spills and divert same from catch basins and water courses.

EROSION CONTROL

The Contractor shall install and maintain soil erosion and sediment control measures as indicated on the drawings and as directed by the Engineer.

STOCKPILING

The Contractor shall use environmentally suitable stockpiling sites for the purpose of storing materials, equipment and suitable backfill material. Environmentally suitable sites shall be level, devoid of mature stands of natural vegetation, and be removed from drainage facilities and features, wetlands, streams and stream corridors.

Portions of the construction sites within the construction area boundaries may be utilized as environmentally suitable stockpiling areas.

The Contractor shall use silt fence barriers and shall erect temporary fencing or other barriers to mark the boundary of the stockpile areas. Where fill is to be stored in excess of 14 days, the Contractor shall employ a suitable means of protecting excavated material from wind and water erosion. Erosion control methods may include one or more of the following: mulching, sprinkling, snow fencing, burlap fencing and gravel covering.

Proposed erosion control methods shall be submitted by the Contractor to the Engineer at the Pre-Construction Conference.

DUST CONTROL

The Contractor shall furnish labor, water spray equipment and water, mechanical sweeping equipment, hand brooms, and any other equipment required for control of dust on the project streets or parking lots and any adjacent streets used by the Contractor for access to the project.

As often as required during each working day and particularly prior to each working day's conclusion, areas under immediate construction (including access roads and other area affected thereby) will be swept clean and wet down sufficiently to lay dust to the Engineer's satisfaction. In addition, these areas will be wet down during non-working hours (including weekends) as often as required to keep the dust under control.

The use of calcium chloride or petroleum products for dust control and soil stabilization is prohibited.

NOISE CONTROL

The Contractor shall be responsible for maintaining noise levels to within acceptable limits. To accomplish this he shall limit the number of machinery in operation to only those required, by requiring all equipment to have adequate mufflers, and by limiting construction activities to hours between 8:00 a.m. and 5:00 p.m. except for essential operations such as dewatering.

PROHIBITED CONSTRUCTION PROCEDURES

1. Dumping of spoil material into any stream corridor, any wetlands, any surface waters, or at unspecified locations;
2. Indiscriminate, arbitrary, or capricious operation of equipment in any stream corridors, any wetlands, or any surface waters;
3. Pumping of silt-laden water from trenches or other excavations into any surface waters, any stream corridors, or any wetlands;
4. Damaging vegetation adjacent to or outside of the access road or the right-of-way;
5. Disposal of trees, brush, and other debris in any stream corridors, any wetlands, any surface waters, or at unspecified locations;
6. Permanent or unspecified alteration of the flow line of the stream, and
7. Open burning of project debris.
8. Location of storage stockpile areas in ESA's.
9. Disposal of excess or unsuitable excavation material in wetlands or floodplains, even with permission of the property owner.

PAYMENT

Separate payment for environmental protection measures will not be made. Payment for environmental protection measures shall be included in the price bid for items requiring same.

SECTION 2D – EXCAVATION AND BACKFILL

WORK INCLUDED

The work includes all topsoil stripping/removal, excavation, cuts, fills, import material (if required), backfill, grading, compaction, soil erosion and sediment control compaction mitigation measures, and associated work necessary for the construction of the pavilion structures, walkways, park facilities, utility work, and appurtenances as shown on the plans or required to complete the work per intent of the specifications.

The Contractor is responsible to establish earthwork quantities to complete all cuts and fills. Under no circumstances will additional payment be considered for earthwork bid items required to construct the improvements in accordance with the plans and specifications.

Excavation, fill and backfill work includes transportation, storage in temporary stock piles, backfill, selection, placing and compaction of the various classes of fill and the disposal of unsuitable or surplus materials at approved locations provided by the Contractor. This shall include any and all excavation.

TOPSOIL SEPARATION

The Contractor shall remove and stockpile all topsoil prior to commencing excavation unless he can demonstrate that he can satisfactorily separate the topsoil from other soils during the work. No topsoil shall be removed from the project site without written consent from the Owner.

All areas to be seeded or sodded shall be topsoiled with approved topsoil onsite or imported if required, to the limits approved by the Engineer. Onsite topsoil shall be tested and amended as necessary to meet the topsoil specifications detailed on the plans and within these specifications. Separate payment for testing and amending the onsite topsoil will not be made.

Imported topsoil shall be inspected for approval by the Engineer prior to delivery to the site by representative samples or by visit to the material source. Separate payment for imported topsoil, if used, will not be made.

SOIL EROSION AND SEDIMENT CONTROL COMPACTION MITIGATION

Prior to the installation of the required topsoil, 5" unless otherwise noted, in all open areas, compaction testing, and/or compaction mitigation measures (tilling or discing) to the subsoils, to a depth of 6", shall be completed, and as set forth in the "Standards for Soil Erosion and Sediment Control in New Jersey", specifically the 'Standards for Topsoiling' and the 'Standards for Land Grading'.

All compaction testing shall be completed in the presence of the Engineer.

EXCAVATION AND CLEARANCES

The excavations shall be made to conform with the lines of the finished structures wherever practical. The excavations shall not be carried below the required subgrades. The trench in which pipe, manholes or inlets are to be constructed shall be excavated from the surface and to such depths, and widths (not less than 12 inches nor more than 24 inches greater than the maximum external dimension of the structure) as will give suitable room for bracing and supporting, pumping and draining, and for removing from the excavation any material which the Engineer may deem inadequate for foundation. Any surplus material shall be distributed on the site or removed as directed by the Owner. All excavations shall be of sufficient width to permit work to be done competently, and safely.

The length of the trench to be opened or the area of the surface to be disturbed and restored at any time will be limited by the Owner with regard both to expeditious construction and convenience to the Owner. New trenches will not be excavated if previous trenches are in need of backfilling or labor is needed to restore the surface of the ground to a safe and proper condition.

All excavations for pipelines shall be clear of boulders, rocks, masonry or other similar material which shall be excavated to a level at least six inches below the bottom of the pipe, and shall be fully refilled with approved material mechanically compacted to provide a stable subbase. Rock or boulders shall be removed from sides of trenches to 12 inches minimum outside the wall or the pipe, unless permission to do otherwise is expressly given. Gravel or stone bedding shall be provided, placed and compacted to the minimum depths when indicated on the plans or as ordered by the Engineer. The bottom of the trench shall be excavated where the earth is suitable for good foundation to the form and size of the lower portion of the pipe or other structure, so that there shall be full and adequate support for the structure which is to be built on it. Ample excavation shall be made under and around the pipe joints for joining and to relieve the bell of shearing forces.

UNAUTHORIZED EXCAVATION

Special care will be taken with the final six inches of all excavations. In no case shall the excavation be carried below the required subgrade by machine and backfill used to establish the required grade. Where the excavation has been carried below subgrade, the Contractor shall, at his own expense refill such areas with compacted 3/4 inch graded gravel or crushed stone to insure the stability of the structure or pipe. If the Contractor excavates below the required subgrade for structures, the over-excavation shall be filled with material subject to the requirements of the Engineer and may include 2000 psi concrete if so ordered by the Engineer, at no additional cost to the Owner.

SHEETING AND BRACING

The Contractor shall fully comply with the applicable requirements of Federal and New Jersey OSHA.

Where necessary for safety or to prevent disturbance, damage or settlement of adjacent structures, pipelines utilities, improvements or paving, excavations shall be sheeted and braced. Any damage to new or existing structures occurring through settlement, water or earth pressure, or other causes due to inadequate construction procedures of the Contractor in any manner, shall be repaired by the Contractor at his own expense.

DEWATERING AND PROTECTION FROM FLOODING

The Contractor shall dewater the excavations promptly and continuously throughout the progress of the work and shall keep the excavations dry at all times until the structures to be built therein, are completed. Where work is to be performed below groundwater level, the Contractor shall provide, operate and maintain dewatering facilities sufficient to maintain the excavation free from groundwater for the time required to complete the work in the proper workmanlike manner.

The Contractor shall protect uncompleted work from flooding during storms or from other causes. All pipelines or structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected.

All necessary precautions shall be taken to prevent disturbance of, and to properly drain, the areas upon which concrete is poured, and upon which pipe is to be laid. All concrete shall be kept dry for one month after pouring.

BACKFILLING EXCAVATIONS

The Contractor shall backfill excavations around structures, underneath paved areas, sidewalks, and other areas sensitive to settlements with on site material, if acceptable, which shall be compacted to 90 percent of its modified proctor density determined in accordance with ASTM Specifications D-1557-72T.

All lumber, braces, construction articles, and rubbish shall be carefully removed from behind walls of structures and from other excavations to be backfilled. Unless otherwise specified, all trenches or

excavations shall be backfilled and compacted to the original ground surface or to such grades as shall be required. The backfilling outside building walls shall be done in accordance with good practice to prevent after-settlement around all structures and pipelines, and with appropriate equipment to protect same from damage.

The Engineer reserves the right to make such selection of the material for various portions of the backfill as may be required for the satisfactory execution of the work.

Backfill shall not be placed on ground that is frozen, nor shall backfill material be permitted to freeze during placing and compaction.

As soon as practical after the pipe or masonry has been placed and the concrete has acquired satisfactory strength, as determined by the Engineer, the backfilling shall begin and shall be expeditiously completed.

The Contractor shall utilize approved mechanical vibratory compaction equipment to thoroughly consolidate backfill. The backfill shall be installed in approved lifts and compacted to achieve maximum consolidation and minimize subsequent settlement. All backfill in embankments shall be thoroughly compacted by rollers of approved size, type and weight for the particular fill materials.

SITE GRADING

All fill required to provide site grading in accordance with the construction plans shall be of clean material derived from on site general excavation as found suitable by the Engineer or imported material approved by the Engineer. Application of this material shall be as noted in following section entitled "Additional Excavation and Fill". Clay core material shall be furnished and installed per the plans and/or as directed by the Engineer. Representative samples and permeability test results shall be submitted and approved prior to placement of the material. No separate payment will be made for import fill.

ADDITIONAL EXCAVATION AND FILL

Wherever undisturbed material found at the grades shown on the plans for the footings or pipe inverts is not satisfactory in the opinion of the Engineer, the Contractor shall make any additional excavations and disposal of excavated material as directed by the Engineer, and shall refill excavations to the required grade with compacted suitable fill material. The fill material shall be as specified under other applicable sections of these specifications.

Fill material shall be spread in uniform horizontal layers that when compacted shall not exceed 8 inches in thickness. Each lift shall be compacted to 95% of its modified proctor density in accordance with ASTM D-1557-72T. The moisture content of the fill material shall be changed when necessary to attain the specified density. Changing of the moisture content of the fill material shall be accomplished by aerating the soil or by adding water to the fill as required. If wetting or drying is required, each lift shall be thoroughly mixed to insure a uniform distribution of moisture. Compaction shall be accomplished by equipment designed for compacting the type of fill being used as approved by the Engineer. The Contractor shall establish operating procedures to obtain uniform coverage of the area being compacted. During construction, the surface of the fill shall be graded to permit runoff of surface water at all times.

NOTE: All excavated material shall be evaluated by the Engineer or his representatives for the suitability of its re-use within the project for fill material. If the excavated material is found suitable, same shall be used for fill and placed in other locations of the project and compacted in accordance with current NJDOT specifications. Payment for all costs associated with the removal, replacement and compaction of this material as directed by the Engineer shall be included in the unit price bid for all items requiring same. Payment for over excavation or undercutting, only if ordered by the Engineer, shall be made at the unit price bid in the proposal form.

If the material is deemed unsuitable, it will then become property of the Contractor to dispose of in accordance with applicable Local, State and Federal regulations. Payment for the removal and disposal

of unsuitable material shall be included in the prices bid for all items requiring the excavation of the material.

BACKFILLING TRENCHES

No trench or other excavations shall be backfilled until the structure or pipeline in it has been examined and approved. Immediately after inspection and approval the trench or other excavation shall be carefully backfilled with the suitable select excavated material and/or other material as detailed or ordered. Whenever the Engineer deems the excavated material unsuitable for backfilling the Contractor shall furnish acceptable material as may be order by the Engineer. No large rock or frozen earth shall be put in the trench. Suitable material shall be used to fill evenly on both sides of the pipe and carefully tamped or rammed so as not to disturb the pipe joints, at the same time making the filled trench thoroughly compact until the filling reaches one foot above the top of the pipe. When the backfilling has been carried to one foot above the top of the pipe, it shall be thoroughly rammed with tools having faces of 25 to 36 square inches and weighing not less than 20 lbs. Rock in pieces weighing more than 50 lbs. shall not be put in the trench. All spaces between suitable pieces of rock shall be thoroughly filled by backfilling in alternative layers of rock and earth. All sheeting shall be withdrawn, unless otherwise ordered to remain in place in writing by the Engineer.

All pipelines and structures shall be maintained throughout the construction and same shall be left in an equivalent condition or improved condition after completion of construction.

Adequate precautions shall be taken to prevent settlement of existing improvements.

In case water, gas pipes, conduits, or other utilities become broken in the prosecution of the work, the Contractor shall give immediate notice to the proper authorities and shall be responsible for any damage to persons or property caused by such breaks.

If house connections or service pipes supplying water or gas are broken during construction, the Contractor shall immediately repair them at his own expense. Delays, such as would result in adjoining buildings having to do without water or gas for a needlessly long period, will not be tolerated. The municipality reserves the right to remedy such delays by ordering outside parties to make such repairs at the expense of the Contractor.

If directed in writing, the Contractor shall make permanent changes in the location of water and gas mains if they are obstructing the new structures to be built. The cost of such changes will be paid for as extra work based on the valuation made by the Engineer and depend on his decision as to whether the work done is or is not included in the work required and bid for by the Contractor under the contract. In rendering all such accounts the Contractor shall itemize both the labor and material involved and provide other information as may be required by the Engineer.

UNDERGROUND OBJECTS AND UTILITIES

Information as to the location of existing utilities has been collected from various sources, but the result of such investigations as shown on the contract drawings are not guaranteed as to accuracy. The Contractor is particularly directed to the fact that underground objects or material location, elevation, or type is not warranted to be approximately correct (nor can they be assumed to be the only subsurface objects or materials which may be encountered in the work). The Contractor shall make all necessary investigations to satisfy himself as to the existing conditions prior to bidding work. Any deviation in location and number of subsurface utilities and objects field determined by Contractor should be brought to the attention of the Engineer in accordance with Section F4.2 et. seq. of the Standard General Conditions of this contract.

NJDOT Standard Specifications Section 202.03.09.01 REMOVAL OF EXISTING SANITY SEWER

The contractor shall remove all sanitary sewer mains, manholes, laterals, risers, and cleanouts as indicated on the plans or as directed. Manholes, mains and laterals shall be flushed clean of all sewage prior to removal. The manholes, mains, laterals and all debris shall be disposed of in accordance with Subsection 201.09. All manhole castings shall be delivered to the Owner, as directed.

Asbestos cement pipe, if encountered and removed, shall be removed and disposed of in accordance with Section 202.03.09.02, as well as all applicable federal, state, and local requirements, including, but not limited to, current USEPA regulations (NESHAP, 40 CFR 61 Subpart M); OSHA regulations (29 CFR 1926.58);, the current New Jersey asbestos hazard abatement subcode (N.J.A.C. 5:23-8); the current NJDEP regulations (N.J.A.C. 7:26-1 et. seq.); and notification regulations (N.J.A.C. 5:23-8.6, 40 CFR 61 Subpart M, and N.J.A.C. 7:26-2:12), as well as applicable health and safety monitoring requirements.

REMOVAL AND DISPOSAL OF ASBESTOS CEMENT PIPE

The contractor shall comply with all applicable Federal, State and local regulations, do all excavation, disconnect from existing structures, cut, remove, handle, wrap, transport and dispose of asbestos cement (transite) pipe in accordance with the local health jurisdiction regarding general safety, security, insurance, pollution and asbestos related requirements.

The Contractor's work shall include all excavation, transportation, procedures backfill, labor, tools, materials and equipment required for the safe removal and disposal of the asbestos cement (transite) pipe. Asbestos cement pipe shall include all such pipe encountered, including, but not limited to, sanitary sewer and water mains, laterals, risers, and cleanouts.

The Contractor shall be responsible for fully informing himself of all regulations that may apply to the above specified activities. Neither the Owner nor its representatives are responsible for informing the Contractor of his legal responsibilities. All references to codes and standards within this specification are made for informational purposes only. They are not intended, nor shall be interpreted, as all inclusive. The Owner and its representatives shall not be liable for the Contractor's negligence in complying with any applicable codes, laws, or regulations not cited in this specification.

In cases of conflict between this specification and any applicable codes, law and/or regulation, the stricter coding shall apply and shall be enforced.

The contractor is advised that the county landfill does not accept transite pipe and accordingly the contractor is responsible for securing a hazardous waste landfill, or other approved disposal facility subject to NJDEP requirements, outside the state which will accept the pipe.

All asbestos removal work shall comply with: the current United States Environmental Protection Agency (USEPA) regulations (NESHAP, 40 CFR 61 Subpart M), National Emission Standards for Asbestos; the current Occupational Safety and Health Administration (OSHA) regulations concerning construction (29 CFR 1926.58); the current New Jersey Asbestos Hazard Abatement Subcode (NJAC 5:23 8); and the current New Jersey Department of Environmental Protection regulations concerning waste transport (NJAC 7:26 1 et. seq.).

The Contractor shall be responsible for all proper notification, including, but not limited to those required by NJAC 5:23 8.6, 40 CFR 61, Subpart M, and NJAC 7:26 2:12.

A copy of the waste manifest indicating the chain of custody and disposal site and date shall be provided for each waste container or truck within five working days of the job completion.

Prior to the commencement of the work, the Contractor shall submit the following:

1. Work schedule including the hours to be worked on a daily basis, and the Contractor's plans for completing the work.

2. Copies of all notifications as required by this specification including, identification of the Contractor's waste hauler, the hauler's NJDEP identification number, and intended disposal site of contaminated wastes.
3. The name of the testing laboratory providing the Contractor's OSHA compliance monitoring.
4. The name and qualifications of the individual who will act as the project supervisor during the asbestos removal portion of the project.

The Contractor is required to provide a fluent English speaking individual to act as a full time representative of the Contractor's organization (i.e. project supervisor) during all activities at the work site. This individual must be authorized to make decisions concerning Scope of Work situations. The name and qualifications of the individual must be submitted at the pre construction meeting, and be approved by the Owner and their representatives.

The Contractor shall also provide health and safety monitoring during the course of the work and shall prepare a health and safety plan in accordance with all appropriate OSHA requirements prior to starting work. The health and safety plan must be implemented by the contractor's site safety officer.

The Contractor is responsible for providing OSHA required air monitoring for his personnel.

The Contractor shall submit documentation indicating that all on site personnel have satisfactorily passed the 40 hour OSHA Basic Health and Safety Training Course and have had the current annual refresher course.

The Contractor shall be responsible for all asbestos removal and disposal. The Contractor shall hold a valid New Jersey Class "A" Asbestos Removal License or employ a subcontractor who does.

The asbestos removal processes are to be performed by competent persons trained, knowledgeable, and qualified in the techniques of abatement, handling and disposal of asbestos containing materials. All asbestos removal workers and supervisors shall possess a current, valid permit from the New Jersey Department of Labor.

Transportation and disposal of asbestos containing and asbestos contaminated waste shall be in accordance with the requirements of the Department of Health of the County, in addition to any federal and state requirements. A copy of these requirements may be obtained by contacting the Department of Health during business hours.

The Contractor will be required to contact the County Health Department upon encountering transite pipe and prior to transport and disposal. The Contractor shall retain a firm to act as the Asbestos Safety Control Monitor (ASCM) during all abatement activities specified herein. The Contractor's designated individual responsible for coordination of the asbestos removal shall maintain continuous contact with the ASCM's Asbestos Safety Technician (AST) and is expected to respond to requests made by the AST or other representatives of the ASCM on matters concerning the abatement work.

During excavation in areas where asbestos cement pipe may exist, the Contractor shall have a crew sufficient to implement the work procedures described below, on call, and able to respond and mobilize at the site within 24 hours.

The area surrounding each location shall be secured by erecting barriers or warning tape a minimum of ten feet in all directions. OSHA approved asbestos hazard warning signs shall be posted at the perimeter of the secured area. The Contractor shall be responsible for controlling access into the secured area to properly trained and protected personnel only. The area surrounding the asbestos cement pipe to be removed shall be excavated by hand shovel methods to a depth sufficient to remove the pipe.

The asbestos cement (transite) pipe shall be excavated and removed from the ground. The exterior of the pipe shall be treated with encapsulant and then the pipe shall be removed as intact as possible. If cutting is required to remove the pipe, it shall be kept to a minimum and accomplished using a cutting tool equipped with a local vacuum attachment fitted with a HEPA filter. Once the pipe is removed, all newly exposed surfaces of the pipe shall be treated with encapsulant and it shall be placed in a double 6 mil plastic bag with OSHA approved warning labels printed on the outside of the bag. The bag shall then be secured with duct tape. This procedure is known as "double bagging." An OSHA approved asbestos waste warning label shall be affixed to the outside of the wrapping.

The wrapped pipe shall be disposed of in accordance with NJAC 7:26.

Reference to encapsulant shall mean a commercially available removal encapsulant such as EPA 55 as manufactured by Arpin Products, or equivalent.

It is suggested that the contractor consult with the disposal facility in order to determine the maximum length of pipe it will accept.

The Contractor must provide proof of insurance as required by the State of New Jersey and any and all other applicable insurance requirements.

Ten days prior to the intended disposal, a notification letter should be sent to the NJDEP. This letter should include the following:

1. Location of job
2. Amount of pipe
3. Type of pipe
4. Name and NJDEP # of hauler
5. Destination of pipe
6. Intended date of disposal

This notification letter is to be sent to:

**Mr. Terrence McAdams
NJDEP Division of Solid Waste Management
CN 414
540 Bear Tavern Road
Trenton, NJ 08625**

MEASUREMENT AND PAYMENT

Separate payment for excavation, cuts, fills, compaction and import fill required to achieve proposed grades of the new improvements and removal and disposal of all material deemed excess or unsuitable including all labor, equipment and material will not be made. Payment shall be included in the price bid for all items requiring same. **Under no circumstances will additional payment be considered for general earthwork items required to construct the improvements in accordance with the plans and specifications.**

Separate payment for dewatering will not be made, all costs associated with dewatering shall be included in the prices bid.

Separate payment for soil erosion and sediment control measures, including all compaction testing, and/or performing compaction mitigation (tilling or discing), will not be made. Soil erosion and sediment control measures shall be in accordance with the project drawings and as directed by the Engineer. Compensation for this material and work shall be included in items requiring same.

SECTION 2E –STONE AND IMPORT FILL

WORK INCLUDED

The Contractor shall furnish and install, only where ordered by the Engineer or where required by the contract documents, stone as may be required for pipe bedding, road base, or for other purposes required by the Engineer. The work includes furnishing, installation and compaction of the material as required by the specifications.

The Contractor shall furnish and install import fill, as required, to meet the proposed grading plan. The Contractor shall provide a calculation of the import fill required to achieve the proposed grades and deliver to the engineer at the preconstruction meeting in order to determine the number of tests required to be provided by the contractor to the engineer.

MATERIALS

General import fill as required to achieve proposed grades shall consist of clean soil aggregate or soil aggregate and rock meeting the requirements of the New Jersey Department of Transportation Standard Specification for Road and Bridge Construction 2007 Subsection 203.03 for I-13 Soil Aggregate. Soil Aggregate shall conform to Subsection 901.11. Placement, lift thicknesses and compaction of all fill material shall be in accordance with current NJDOT Specifications and the construction details. The top eighteen inches (18") of fill placed shall not contain stones or similar objects larger than two inches (2") in any dimension.

Contractor shall comply with NJAC 7-26D where applicable.

The following shall also be required for import fill material to the site:

- Fill shall be compacted in 12" maximum lifts
- Each lift shall be compacted to 95% of its modified proctor density in accordance with ASTM D-1557-72T
- Delivery tickets shall be provided for all imported material
 - Tickets shall identify the source of the material and Cubic Yardage or Tonnage of material provided
- Imported material shall be subject to the submission of gradation test results, priority pollutant plus forty test requirements, and material source. One set of test results shall be provided for every 10,000 cubic yards of imported material or a minimum of one per source. Further, any recycled material to be utilized must come from a state licensed recycling facility.

Gradation of I-13 soil aggregate shall conform to the following:

NJDOT I-13 Soil Aggregate

<u>US Standard Sieve Size</u>	<u>Percent Finer By Weight</u>
4"	100
No. 4	30-100
No. 200	0-12

Clean Stone for undercut areas, pipe bedding or surface treatment (only if ordered by the Engineer) shall be cleaned crushed trap rock (3/4") of a quality equal to that required by the New Jersey Department of Transportation "Standard Specification for Road and Bridge Construction - 2007".

Subbase shall be Dense Graded Aggregate (DGA) meeting the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction 2007, Section 901.10, installed at locations required by the plans or as ordered by the Engineer, graded and compacted to the lines and grades required.

MEASUREMENT AND PAYMENT

Separate payment for clearing, excavation, grading, disposal of excess material, and compaction required to complete the work for the items described in this section will not be made. Compensation for said work shall be included in the prices bid for all items requiring same.

Separate payment for suitable general import fill if required to achieve proposed subgrades per plan will not be made. Compensation for import fill shall be included in the price bid for items requiring same.

SECTION 2F– CONCRETE SITE WORK

WORK INCLUDED

The work shall consist of the construction of Portland cement concrete structures as shown on the contract drawings and all other incidental concrete work as directed by the Engineer.

The Contractor shall provide all labor, materials and equipment required to construct foundations and footings, concrete pads including the custom concrete compass rose inlay, concrete walkways and patios at the locations shown on the plans. Appropriate expansion and construction joints shall be installed under the direction of the Engineer.

QUALITY ASSURANCE

Construction of concrete structures shall comply with provisions of the latest editions of the following codes, specifications and standards, except where more stringent requirements are shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings".
2. ACI 318 "Building Code Requirements for Reinforced Concrete".
3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

The Contractor shall employ, at Contractor's expense, a testing laboratory acceptable to Engineer to design concrete mixes and perform material evaluation tests related to the concrete mixes. Materials and installed work may require testing and retesting, as directed by Engineer, at any time during the progress of work. The Contractor shall allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense, including retesting and rejected materials and installed work shall be done at contractor's expense.

SUBMITTALS

The Contractor shall submit the manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing compounds, and others as requested by Engineer.

The Contractor shall submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required and openings through concrete structures.

The Contractor shall submit samples of materials as specified and as otherwise requested by Engineer, including names, sources and descriptions. Laboratory test reports for concrete materials and mix design tests shall be submitted if requested by the Engineer.

The Contractor shall provide materials certificates for cement, aggregates, admixtures, reinforcing, welded wire fabric, non-shrink grout, curing compounds and non-slip aggregates. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

FORM MATERIALS

Formwork for exposed concrete surfaces shall be plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system

when shown on drawings. Provide form material of sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

Formwork for unexposed concrete in finished structure shall be with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

All forms shall be provided with commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

REINFORCING MATERIALS

Reinforcing materials for all concrete structures shall comply with the following:

1. Reinforcing Bars: ANSI/ASTM A 615, Grade 60, deformed.
2. Steel Wire: ANSI/ASTM A 82, plain, cold-drawn, steel.
3. Welded Wire Fabric (WWF): ANSI/ASTM A 185, welded steel wire fabric.
4. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise acceptable.

CONCRETE MATERIALS

Concrete materials for all concrete structures shall comply with the following:

1. Portland Cement: ANSI/ASTM C 150, Type I, unless otherwise acceptable to Engineer.
2. Normal Weight Aggregates: ANSI/ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
3. Water: Potable.
4. Air-Entraining Admixture: ANSI/ASTM C 260, and shall be an aqueous solution of completely neutralized vinsol resin.
5. Water-Reducing Admixture: ANSI/ASTM C 494, Type A, and contain not more than 0.05% chloride ions.
6. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G and contain not more than 0.05% chloride ions.
7. Non-Corrosive, Non-Chloride Accelerator Admixture: ASTM C 494, Type C or E, and contain no more chloride ions than are present in municipal drinking water. The manufacturer must have long-term test data (at least a year), from an independent testing laboratory, concerning corrosion using an acceptable accelerated corrosion test method such as that using electrical potential measures.
8. Water Reducing, Retarding Admixture: ASTM C 494, Type D, and contain not more than 0.05% chloride ions.
9. Calcium chloride, or admixtures containing more than 0.05% chloride ions are not permitted.

10. Certification of conformance to the above mentioned requirements and the chloride content of the admixture will be required from the admixture manufacturer prior to review of mix design.

11. Non-Shrink Grout: CRD-C-621-89a, Grade "C" (equipment grouting) or Grade "B" (Construction Grouting), Corps of Engineers Specification for Non-Shrink Grout, Type D, Non-metallic. In addition, the manufacturer shall furnish data from an independent laboratory indicating that the grout, when placed at a fluid consistency shall achieve 95% bearing under a 4'x4' base plate.

12. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

13. Liquid Membrane-Forming Curing and Sealing Compound: Water-based acrylic type, 30% solids content minimum, and have test data from an independent testing laboratory indicating a maximum moisture loss of 0.55 kg per sq m in 72 hours when applied at the coverage rate recommended by the manufacturer.

14. Patching Mortar: Free-flowing, polymer-modified cementitious coating.

15. Bonding Admixture: The compound shall be a latex, non-rewettable type.

PROPORTIONING AND DESIGN OF MIXES

The Contractor or Contractor's representative shall prepare design mixes for each type and strength of concrete by either laboratory, the trial batch, or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to Engineer. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Engineer. If trial batch mixes are used, the mix design shall achieve an average compressive strength 1200 psi greater than the specified strength.

The Contractor shall submit written reports to the Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. The Contractor shall not begin concrete production until the Engineer has reviewed mixes. Design mixes shall provide normal weight concrete as indicated on contract drawings.

Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

The mix design shall use water-reducing admixture or high range water-reducing admixture (super plasticizer) in all concrete. High range water-reducing admixture shall be used in all concrete to be pumped and all concrete containing synthetic fiber additive.

Non-corrosive accelerating admixture shall be used in concrete slabs placed at ambient temperatures below 50°F (10°C). Air-entraining admixture shall be used in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits:

Concrete structures and slabs exposed to freezing and thawing or subjected to hydraulic pressure:

1. 5.5% for 1 ½" – 2" aggregate.
2. 6% for ¾" – 1" aggregate.
3. 8% for 3/8" – ½" aggregate.

All interior slabs subject to vehicular abrasion shall have a maximum air content not greater than 3%.
Other Concrete: 2% to 4% air.

Slump Limits: Proportion and design mixes to result in concrete slump at truck as follows:

1. Ramps and sloping surfaces: Not more than 3".
2. Reinforced foundation systems: Not less than 1" and not more than 3".
3. Concrete containing HRWR admixture (super plasticizer): Not more than 8" after addition of admixture nor more than 3" prior to addition of admixture.
4. Other concrete: Not less than 1" and not more than 4".

CONCRETE MIXES

Ready-Mix Concrete shall comply with requirements of ANSI/ASTM C94 and as herein specified. Addition of water to the batch will not be permitted. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ANSI/ASTM C 94 may be required. When air temperature is between 85°F (30°C) and 90°F (32°C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

FORMS

The Contractor shall design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

Forms shall be fabricated for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

Temporary openings shall be provided where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings if forms at inconspicuous locations.

Chamfer exposed corners and edges, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

Form Ties shall be factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is at least 1-1/2" inside concrete and will not leave holes larger than 1" diameter in concrete surface.

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

PLACING REINFORCEMENT

Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete. Accurately position, support and secure reinforcement (including welded wire fabric) against placement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

Reinforcement shall be placed to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and tie splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

JOINTS

Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Engineer.

Provide keyways at least 1-1/2" deep in construction joints in walls, slabs and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

Place construction joints of members perpendicular to the main reinforcement. Continue reinforcement across construction joints or structural members.

Isolation Joints in Slabs-on-Ground: construct isolation joints in slabs-on-ground at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.

PREPARATION OF FORM SURFACES

Contact surfaces of forms shall be coated with a form-coating compound before reinforcement is placed. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

Steel forms shall be coated with a non-straining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

CONCRETE PLACEMENT

Before placing concrete, the Engineer shall inspect formwork installation, reinforcing steel, and items to be embedded or cast-in. The Contractor shall notify other crafts to permit installation of their work and shall cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

The Contractor shall coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

Concrete shall be deposited continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as

nearly as practicable to its final location to avoid segregation. Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

When placing concrete in cold weather, protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C) at point of placement. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

Only the specified non-corrosive non-chloride accelerator shall be used. Calcium chloride, thiocyanate or admixtures containing more than 0.05% chloride ions are not permitted.

When placing concrete in hot weather, low humidity or dry winds or other conditions suitable for plastic cracking, the evaporation retarder "Eucobar" by The Euclid Chemical Co. or "Confilm" by Master Builders may be required to be applied by spray one or more times during the finishing operation. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32°C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.

Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

Forms shall be wetted thoroughly before placing concrete.

Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

FINISH OR FORMED SURFACES

Rough form finish shall be used for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding ¼" in height rubbed down or chipped off.

Smooth form finish shall be used for formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

Smooth rubbed finish shall be used, where indicated, which have received smooth form finish treatment, not later than on day after form removal.

At tops of walls, horizontal offsets and surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

MONOLITHIC SLAB FINISHES

Float finish shall be applied to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation to power driven floats, or both consolidate surface with power-driven floats, or by hand-floating is area is small or inaccessible to power units. Check and level surface plane to a tolerance of $F_1/20/F_1/17$. Cut down high spots and fill low spots, refloat surface to a uniform, smooth, granular texture.

Trowel finish shall be applied to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface leveled to a tolerance of $F_1/25/F_1/20$. Surface defects which would telegraph through applied floor covering system are to be ground smooth.

Non-slip broom finish shall be applied to exterior concrete platforms, steps and ramps, and elsewhere as indicated. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

CONCRETE ROADWAY TRENCH REPAIR

Roadway trench repair shall consist of the construction of 6" of dense graded aggregate base course and concrete surface course at the thickness of the existing concrete surface course slab. The roadway trench repair shall be constructed on top of the compacted trench backfill, and the finished surface shall match the existing elevation of the adjacent pavement.

CONCRETE CURING AND PROTECTION

The Contractor shall protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

Initial curing shall be started as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days. Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

Concrete surfaces shall be covered with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

The specified curing and sealing compound shall be applied to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

Membrane curing compounds shall be used that will not affect surfaces to be covered with finish materials applied directly to concrete.

Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of appropriate curing method.

REMOVAL OF FORMS

Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, may not be removed until concrete has attained design compressive strength (f'_c) but in no case shall the forms be removed in less than 14 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or membrane.

REUSE OF FORMS

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

When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

CONCRETE SURFACE REPAIRS

All defective areas shall be repaired and patched with cement mortar immediately after removal of forms, when acceptable to Engineer.

Cut out honeycomb, rock packets, voids over ¼ inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.

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

The Contractor shall remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.

The Contractor shall repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

Unformed surfaces, such as monolithic slabs, shall be tested for smoothness and verify surface lane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.

The Contractor shall repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01 inch wide or that penetrate to

reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.

High areas in unformed surfaces shall be corrected by grinding after concrete has cured at least 14 days. Low areas in unformed surfaces shall be corrected during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Repaired areas shall be finished to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Engineer.

The Contractor shall repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least ¾-inch clearance all around. Dampen concrete surfaces in contact with patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

The Contractor shall perform structural repairs with prior approval of Engineer for method and procedure, using specified epoxy adhesive and mortar. Repair methods not specified above may be used, subject to acceptance of Engineer.

Repair materials and alternate methods (if any) shall be submitted during the shop submittal process for review and approval.

CONCRETE CURB, IF APPLICABLE

The Contractor shall provide all labor, materials and equipment required to concrete curbing at the locations shown on the plans. Appropriate expansion and construction joints shall be installed under the direction of the Engineer.

Concrete shall be NJDOT Class B and manufactured in accordance with American Society for Testing and Materials, C-94 (latest revision) "Specification for Ready-Mixed Concrete" and shall originate in a ready-mix plant that has been certified and approved by the National Ready-Mixed Concrete Association. The Contractor shall submit to the Engineer a copy of the certification prior to the delivery and placing of any concrete on this project. Coarse aggregate proportions shall conform to American Society for Testing and Materials, Concrete Aggregation C-33, Size No. 57 or 67. Concrete will be air-entrained, and the amount of air shall be five percent, plus or minus one percent. Concrete shall be placed to true grade. Subgrade shall be in accordance with the design details, but not less than 4" of ¾" of clean crushed stone. Payment for stone subgrade shall be included in the price bid for the concrete sidewalks/slabs.

The Contractor shall be responsible for all excavation or fills, grading, removal of excess unsuitable material, stone sub-base and restoration necessary to complete the concrete installation. No additional payment will be made for said excavation, fill, compaction, sub-base stone, grading and restoration, but shall be included in the unit price bid for the concrete sidewalks/slabs and concrete curb.

COMPASS ROSE INLAY

The Contractor shall provide all labor, materials and equipment required to satisfactorily construct the custom compass rose inlay, within the concrete paver patio, as shown in the plans.

It is anticipated the contractor will construct the concrete block walls, then the sub-base of the concrete paver patio area, prior to the installation of the compass rose inlay. After the compass rose inlay has been constructed, the contractor will install the concrete pavers, cut to fit around the compass rose inlay.

The Contractor shall utilize expansion joint type saw cuts, as outlined above, to create the specific design, as shown on the drawings.

The contractor shall submit construction methods, layout, and color selections of the compass rose inlay during the shop submittal process. The final color selection will be determined by the Owner.

MEASUREMENT AND PAYMENT

Separate payment for concrete pads, foundations, and footings will not be made. Payment for said items shall be included in the bid price for all items requiring same.

Separate payment of the compass rose inlay will not be made. Payment shall be included in the bid price for the concrete paver patio and walkway.

Causes for Rejection of Concrete Walks

Concrete walks shall be rejected and ordered replaced by the Engineer if any or all of the following should occur or exist:

- A. Staining or discoloration of concrete sidewalk.
- B. Walk is out of alignment.
- C. Walk is out of grade.
- D. Joints and surfaces are improperly finished.
- E. Expansion joints protrude from concrete.
- F. Cracks, chips, or other damages occur during construction or maintenance period.
- G. Settlement of walk
- H. Inspection not asked for prior to pouring of concrete.
- I. Improper vibration of concrete.
- J. Vandalism during initial setup of concrete.

Payment for the removal and disposal of existing walks and driveways shall be made as specified in Sections 201 and 202 of the NJDOT specifications.

Separate payment will not be made for removal, disposal, and replacement of walks rejected due to the causes of rejection listed above.

SECTION 2G – PAVILION IMPROVEMENTS AND RESTROOM BUILDING

WORK INCLUDED

The contractor shall install the Pavilion and Restroom Building at the location indicated on the plans. All materials, labor and equipment required to complete the installation and all incidental items required by the plans and specifications shall be included under this item.

The contractor shall review the Appendix of these specifications for the architectural plans and specifications associated with this building.

The contractor or manufacturer is responsible for obtaining all permits. All construction shall comply with applicable codes.

Installation of all components shall be in strict conformance with the architectural detail drawings and/or with the manufacturer's instructions and recommendations as directed by the Engineer.

MEASURE AND PAYMENT

Measurement and payment will be made under:

Pay Item

PAVILION IMPROVEMENTS, INCLUDING EXCAVATION,
EARTHWORK AND GRADING, CONSTRUCTION OF IN-KIND
PAVILION STRUCTURE, CONNECTION OF UTILITY SERVICES,
INSTALLATION OF CONCRETE WALKWAY AND PATI (283 SY)
TO SERVICE BUILDING, SITE PROTECTION AND RESTORATION,
AND ALL OTHER MATERIALS AND SERVICES FOR A COMPLETE
AND FULLY FUNCTIONAL BUILDING

Pay Unit

LUMP SUM

Payment for the furnishing and installation of the pavilion improvements including all requirements, specifications and responsibilities as listed within the above specification and architectural plans will be made at the lump sum price bid as listed in the Bid Form. Said bid prices shall include all materials, labor and incidentals required to complete the installation. No separate payment will be made for signed and sealed drawings.

Separate payment for all items requiring coordination, construction permits, inspections and fees will not be made while obtaining a Certificate of Occupancy. Compensation for these items shall be included in the price bid for said items.

Final payment for the pavilion structure will not be released until the contractor obtains a Certificate of Occupancy for same.

SECTION 2H – CONCRETE PAVERS AND CAST STONE WALL

WORK INCLUDED

The contractor shall construct concrete paver walkways, patio areas and concrete paver block wall as designated on the plans, including all excavation, sub-base material, foundations, reinforcement, edging and labor necessary.

MATERIALS

CONCRETE PAVER WALKWAY AND PATIO

The concrete pavers shall be the 'Coventry Brickstone' as manufactured EP Henry (800-444-3679), or an approved equal. The soldier course shall be 'Pewter Blend 16' and the field shall be 'Harvest Blend 16' in a herringbone pattern.

The pavers shall be installed in accordance with the manufacturer's instructions and with the construction details.

Bedding sand shall conform to Subsection 901 of the NJDOT Standard Specifications for Road and Bridge Construction, Latest revision.

Aggregate base shall conform to Subsection 901 of the NJDOT Standard Specifications for Road and Bridge Construction, Latest revision.

Edge restraint along the paver areas is required. The type of edge restraint shall be as approved by the Engineer. No separate payment will be made.

CONCRETE PAVER BLOCK WALL

The concrete paver block wall shall be the 'Cast Stone Wall Block' as manufactured EP Henry (800-444-3679), or an approved equal. Color shall be 'Aspen'.

The concrete paver block wall cap shall be 'Cast Stone Wall Cap Devonstone' as manufactured EP Henry (800-444-3679), or an approved equal. Color shall be 'Bluestone'.

The paver wall block and cap shall be installed in accordance with the manufacturer's instructions and with the construction details.

Bedding sand shall conform to Subsection 901 of the NJDOT Standard Specifications for Road and Bridge Construction, Latest revision.

Aggregate base shall conform to Subsection 901 of the NJDOT Standard Specifications for Road and Bridge Construction, Latest revision.

MEASUREMENT AND PAYMENT

Measurement and payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
CONCRETE PAVER PATIO AND WALKWAY, INCLUDING COMPOSE ROSE INLAY AND SUB-BASE	SQUARE YARD
CAST STONE CONCRETE BLOCK WALL, 12" HIGH, INCLUDING SUB-BASE	LINEAR FOOT

Payment for construction of the concrete block paver patio and walkways will be made at the square yard price bid as listed in the bid form for the quantity actually installed. No separate payment will be made for labor, materials, sub-base, or any appurtenances necessary for a complete installation.

Payment for construction of the cast stone concrete block wall will be made at the linear foot price bid as listed in the bid form for the quantity actually installed. No separate payment will be made for labor, materials, sub-base, or any appurtenances necessary for a complete installation.

SECTION 2I – PREFABRICATED GAZEBO STRUCTURE

WORK INCLUDED

The contractor shall furnish and install the Custom 19' Wide Prefabricated Gazebo Structure at the location indicated on the plan. All materials, labor, permitting, and equipment required to complete the installation, including all foundations, connections and all incidental items required by the plans, specifications, or manufacturer's recommendations shall be included under this item.

The contractor shall provide shop submittals detailing layout, concrete foundations, reinforcement and execution for review and approval prior to construction. Plans and details signed and sealed by a N.J. Licensed Engineer will be provided by the gazebo manufacturer for submittal to the construction department for all permitting. The contractor will be responsible for obtaining all permits from the local sub-code officials. All construction shall comply with applicable codes. Any required soil borings and testing for bearing capacity determination is the responsibility of the contractor.

Installation of all components shall be in strict conformance with the detail drawings and/or with the manufacturer's instructions and recommendations, or as directed by the Engineer.

The contractor is responsible for furnishing the required anchor bolts to secure the structure.

MATERIALS

The Custom 19' Wide Prefabricated Gazebo Structure (Model #: OC22-9M3C-P6-30-100-100~52816) shall be as shown on the detail drawings, manufactured by ICON Shelters and provided by Ben Shaffer Recreation, Inc. (973-663-2021) or approved equal.

MEASURE AND PAYMENT

Measurement and payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
CUSTOM 19' WIDE PAVILION STRUCTURE, INCLUDING CONCRETE FOUNDATIONS AND MOUNTING	UNIT

Payment for furnishing and installing the custom gazebo structure will be made at the unit price bid as listed in the Bid Form. Said bid prices shall include all materials, labor and incidentals required to complete the installation. No separate payment will be made for signed and sealed drawings.

Separate payment for all items requiring construction permits will not be made. Compensation for these items shall be included in the price bid for said items.

SECTION 2J – DECORATIVE BENCHES

WORK INCLUDED

The contractor shall furnish and install the decorative benches, as specified, and where shown in the drawings.

Installation of all components shall be in conformance with the detail drawings and/or with the manufacturer's instructions and recommendations as directed by the Engineer.

MATERIALS

Decorative benches shall be Model 165-60PL-S2, 6' long, black in color with cedar colored recycled plastic slats; decorative backless benches shall be Model 166-60PL-S2, 6' long, black in color with cedar colored recycled plastic slats as manufactured by Dumor, Inc. (General Recreation, Inc., 973-403-6831) or approved equal. Permanent installation shall be in accordance with the detail drawing. Contractor shall submit shop drawings for approval prior to ordering.

Decorative benches located on concrete paver patio shall be surface mounted on the concrete pavers and a 4" concrete pad, located below the pavers, for permanent attachment to the benches. Contractor to ensure bolting is secured to the concrete pad.

MEASUREMENT AND PAYMENT

<u>Pay Item</u>	<u>Pay Unit</u>
6' LONG DECORATIVE BENCH, INCLUDING CONCRETE PAD AND PERMANENT ANCHORING	UNIT
6' LONG DECORATIVE BACKLESS BENCH, INCLUDING CONCRETE PAD AND PERMANENT ANCHORING	UNIT

Payment for furnishing and installing the decorative benches, as specified, will be made at the unit price bid for said items as listed in the Bid Form. Said bid prices shall include all materials, labor and foundations/and or concrete pads required for permanent anchoring and installation.

SECTION 2K - TOPSOIL, LIME, FERTILIZER AND HYDRO SEED

WORK INCLUDED

The Contractor shall provide all labor, materials, and equipment necessary to furnish and install topsoil, lime, fertilizer, and seed/sod in accordance with the specifications and where indicated on the plans.

It is intended to provide topsoil, lime, fertilizer, and seed/sod for all those areas of the site that have been disturbed during the work on this contract.

The Contractor shall furnish and install seed throughout the site as required to complete the work as intended by the plans or required by the Engineer. The work also includes the furnishing and placement of topsoil to provide the required covering throughout the area to be sodded and throughout those areas disturbed by the Contractor.

Proposed topsoil thickness shall be a minimum of 5" unless otherwise indicated on the plans.

TOPSOIL

All topsoil taken from original excavations, if available, shall be carefully and separately stored and, after completion of the rough grading, shall be shredded, screened (using a 3/8" vibratory harp deck), spread, graded, and rolled to conform with the elevations shown on the drawings or as directed by the Engineer. Additional topsoil as required for these areas shall be furnished by the Contractor at no additional cost. A minimum thickness of topsoil of 5" will be required. All stockpiled topsoil shall be thoroughly cleared of all sticks, roots, branches, coarse sods and other deleterious matter, and all stones larger than 2" in diameter before it's spread. Topsoil shall not be handled or spread when it is in a frozen or muddy condition, or otherwise unsuitable for handling.

Import Topsoil: (if and where deemed necessary)

Additional topsoil to be imported if required shall be screened topsoil approved by the Engineer. The material shall be inspected and written approval received by the contractor prior to delivery to the site. Inspection shall be by representative samples or by onsite inspection at the source by, and at the discretion of the Engineer. Imported topsoil shall be free of glass, plastic and any other non-organic materials. If any such contaminants are discovered after spreading, the topsoil shall be removed and replaced, or the contaminants removed to a degree satisfactory to the Engineer.

Specifications for Imported and / or Amended Onsite Topsoil:

- Unacceptable Topsoil Sources: Do not obtain topsoil from the following sources:
 1. Areas containing chemically contaminated soils
 2. Areas from which the original surface has been stripped or covered over, such as borrow pits, open mines, demolition sites, dumps, and landfills
 3. Wet excavations
 4. Acid producing soils
- Provide topsoil that conforms to the pH requirements specified below, when tested according to ASTM D 4972.

<u>pH Range</u>	<u>Acceptability / Remediation</u>
pH < 4.1	Topsoil is UNACCEPTABLE
4.1 ≤ pH < 6.0	Add pulverized lime to increase the pH to 6.5 before use

$6.0 \leq \text{pH} < 7.0$ Topsoil is acceptable. No remediation needed

$7.0 \leq \text{pH} < 7.2$ Decrease pH to at least 6.8 before use

$\text{pH} \geq 7.2$ Topsoil is UNACCEPTABLE

- Organic Content requirement shall be between the range of 2 to 7 percent by weight. The organic content shall be determined according to AASHTO T 194, except that the sample is to be taken from oven-dried soil passing a No. 10 sieve. Any soil additives being considered to increase the organic content of selected import topsoil needs to be reviewed and approved by the Engineer prior to the amending process.
- Gradation / particle Size: Provide topsoil conforming to the following particle size requirements and that has no more than 20 percent retained on a No. 10 sieve when mechanically graded.

<u>Particle Size</u>	<u>Percent</u>
Sand (2.0mm to 0.05 mm)	60 – 80
Silt (0.05 mm to 0.005mm)	10 – 15
Clay (0.005 mm to smaller)	5 – 10*
Gravel (2.0mm or greater)	< 4

* - If more than 50 percent of the sand portion is larger than 0.5 millimeters, the allowable range for clay is 10 to 20 percent.

No topsoil shall be spread before the completion of all construction in the area or before all fills are fully compacted.

Before spreading topsoil, the sub-grade shall be cleared of all stones more than 2" in diameter, all coarse roots, sticks, and debris. Any portions of the sub-grade that has been compacted to a hard surface shall be pulverized to a depth of 3" by plowing, or other methods acceptable to the Engineer.

LIME, FERTILIZING AND HYDO-SEEDING

A soil analysis shall be provided by the contractor if requested by the owner. Ground limestone shall be evenly applied to all areas to be seeded at the rate to be determined or, at a minimum, 4.5 pounds to every 100 square feet of surface, and shall be thoroughly and evenly mixed with the soil to a depth of 5" below finished grade.

All areas to be seeded shall be fine graded to remove all ridges and depressions and the surface shall be cleaned of all stones greater than 2" in diameter, and other debris.

After preparation for seeding, and at least nine days before seeding, organic fertilizer approved by the Engineer shall be incorporated into the soil at a rate of one ton per acre, to a depth of two inches. The soil shall then be thoroughly watered.

Where regular seed is proposed, seed shall later be spread and raked into the prepared soil at a rate of 0.4 lbs. per 100 sq. ft. Seed shall be rolled with a water ballast roller, and shall be watered, protected, and tended until there is a hardy stand of grass.

All dates and schedules for seeding operations shall be as approved by the Engineer. Seeding shall be done in favorable weather, in the fall, where possible, and in early spring, if necessary, to complete unfinished areas.

Hydro-seed shall be installed in accordance with the manufacturer's package instructions and

recommendations.

Seed to be furnished and installed shall be a high quality seed mix that is traffic and drought resistant and recommended for athletic field use. The specific seed mix proposed shall be approved by the engineer prior to ordering.

Seed mix to be furnished and installed shall be "Team Mates Plus" as distributed by Lesco, Inc., or an approved alternate.

The above seed mix consists of:

70%	Turf Type Tall Fescue Blend
20%	Perennial Ryegrass
10%	Premium Kentucky Bluegrass

The seed shall contain practically no seeds of noxious weeds and shall be delivered mixed in uniform sealed bags with tags/labels showing weights, analysis and vendor's name. Bags and labels shall be saved and given to the Engineer or Owner.

SOD (IF REQUIRED)

Prior to the placement of sod, topsoil conforming to the requirements of other applicable sections of these specifications shall be placed to a minimum 5" thickness over all disturbed areas.

Sod shall be of a tall fescue mix subject to approval of the Engineer. An example of an acceptable sod is "Tuckahoe Fescue Turf" consisting of 45% Millennium Turf Type Tall Fescue, 45% Plantation Turf Type Tall Fescue and 10% Tuckahoe Turf Bluegrass Blend as distributed by Tuckahoe Turf Farms, Inc. of Hammonton, NJ.

Immediately before placing the sod, organic fertilizer applied as described previously, and pulverized limestone if necessary, shall be incorporated into the topsoil. The fertilizer and limestone shall comply with the requirements for same as detailed in other applicable sections of this specification. The sod shall be harvested, and within 36 hours, delivered and placed on the previously prepared bed of topsoil.

With each delivery of sod, a delivery slip shall be submitted with the date of harvest and seed breakdown.

Sod shall be machine cut at a uniform soil thickness of 5/8 plus or minus 1/4 inch at the time of cutting. Measurement for thickness shall exclude top growth and thatch. Individual strips of sod shall be of a uniform width. Broken strips and torn or uneven strips will be rejected. Standard size strips of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from the upper 10 percent of the strip.

Sod shall be a Kentucky bluegrass-fescue blend determined to be adequate for the intended use – the seed mix of the sod proposed shall be approved by the owner or engineer prior to delivery.

The big roll system (250 sq. ft. per roll, 4' wide by 62.5' long) should be utilized to minimize the joints within the laid sod surface.

Sod shall be laid with staggered joints and pressed closely together. The ends of sod strips shall be matched so that the ends and sides always lay flush with each other. Sod shall be pressed into the underlying soil by hand tamping and rolling. Then the sodded areas shall be thoroughly watered.

Watering shall be performed as necessary until a firm root mass is established. Each watering shall be performed until water infiltrates through the root zone and into the topsoil zone. The method of watering shall be performed in a manner that provides equal distribution and coverage to all areas sodded.

Sod shall not be transplanted when the moisture content (excessively wet or dry) may adversely affect its survival. Whenever the upper half inch of topsoil is dry, the soil shall be lightly moistened immediately prior to laying the sod.

The finished surface shall be smooth, even, and to the prescribed lines and contour. Sod that is other than alive and healthy before acceptance shall be replaced immediately by the contractor without additional compensation. At the time of acceptance all sod shall be alive, healthy, and established.

WATERING AND CUTTING LAWNS

The contractor shall take all necessary steps to produce a satisfactory lawn covering. Such steps may include the thorough watering of the new lawn until it has received its second cutting.

The cost of such watering shall be borne by the contractor, and the equipment and manpower required, shall be furnished by the contractor.

The contractor shall also be held responsible for cutting of lawns until the project is closed out and accepted by the owner. Any lawn areas that have not developed after two (2) cuttings shall be cut and re-seeded or sodded, fertilized, watered, and cut until a full lawn is produced. Should crab grass or broadleaf weed prevention be deemed necessary by the engineer, same shall be applied at no additional cost.

The cuttings of lawn shall not occur closer than 7 to 10 days, or as directed by the Engineer.

Lawn areas must be hearty and uniform prior to acceptance by the owner.

MEASUREMENT AND PAYMENT

<u>Pay Item</u>	<u>Pay Unit</u>
TOPSOIL, FERTILIZE, LIME, AND HYDROSEED ALL DISTURBED AREAS OF CHALLENGE GROVE PARK	LUMP SUM

Payment for topsoil, fertilizing, lime, and hydroseeding of all disturbed areas will be made at the lump sum price bid for said item as listed in the bid form.

SECTION 2K - CLEANUP AND RESTORATION

WORK INCLUDED

The Contractor shall, throughout the course of the work, maintain the site in a presentable condition to the satisfaction of the Engineer. The Contractor shall be responsible for all periodic clean-up and coordination or cooperative efforts of all subcontractors. All contractors involved in the work shall cooperate fully with direction by the Engineer and Owner in this regard.

Periodic clean-ups shall include, but is not necessarily restricted to, storage of equipment and material, removal of rubbish, and any material which may either become unsightly or impede progress of the work or cause unsafe conditions. In general, the site shall be maintained in the neat and orderly fashion at all times.

At the conclusion of the workday, the Contractor shall restore all areas damaged due to construction activity. Each contractor shall be responsible for damage due to his operations; however, the general contractor shall assume the overall responsibility for any damage. All contractors and subcontractors shall cooperate with the general contractor in this regard.

Grass, shrubs, walks and other site related work damaged during construction shall be restored to the satisfaction of the Engineer.

The Contractor is responsible to leave the site in a condition intended by the plans and all areas shall be left in a state equal to or better than that existing prior to the start of the contract.

MEASUREMENT AND PAYMENT

Separate payment will not be made. Payment for all clean-up and restoration related work shall be included in the prices bid for all work. A portion of the lump sum price bid for Bid Item 1 based on the approved schedule of values will be retained until final clean-up, restoration and demobilization are complete.

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GENERAL

The Contractor shall provide all electrical work to provide the proposed luminaire within the gazebo structure at the location depicted on the construction plans. The work shall meet the intent of the plans and specifications, while complying with the latest edition of the National Electric Code (NEC). The scope shall provide for complete and fully operational electric components and for Electrical Sub-Code permit application.

SECTION 16010 - BASIC ELECTRICAL REQUIREMENTS

This Section specifies the basic requirements for electrical design and installations. On-site electric facilities shall be underground and be located outside the athletic field boundaries of play.

Electrical Installations:

It is the intent of this Section that all equipment and devices, furnished and installed under this and other Sections, be properly connected and interconnected with other equipment so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Drawings.

The Contractor shall provide a complete electrical installation including all electrical equipment, labor, material, tools, transportation, procurement of all necessary permits, certificates and other incidentals services, whether described in these specifications and Drawings or not, to provide a satisfactory operating electrical installation.

All work shall be performed in strict compliance with the applicable State and Local Codes and the latest edition of the National Electrical Code of the National Fire Protection Association, and the OSHA Standards.

The Contractor shall obtain all permits required to complete the work and, upon completion of the work, obtain and deliver to the Engineer a Certificate of Inspection and Approval from the State Board of Fire Underwriters or other authority having jurisdiction. Pay all fees and costs associated with the securing of all required certificates and permits. These fees and costs shall be included in the bid price.

All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the Insurance Rating Organization having jurisdiction, National Electrical Code (NEC), National Electrical Manufacturer's Association (NEMA), Institute of Electrical and Electronic Engineers (IEEE), Insulated Cable Engineers Association (ICEA), American Society of Testing Materials (ASTM), American National Standards Institute (ANSI), Illuminating Engineering Society (IES), the requirements of the Occupational Safety Hazards Act (OSHA), and all other applicable Federal, State and local laws and/or ordinances, most stringent shall apply. All materials and equipment shall bear the inspection labels of Underwriters' Laboratories, if the material or equipment is of the class inspected by said laboratory.

Any paragraph of requirements in these specifications, or Drawings, deviating from the rules, requirements and specifications of the above organizations shall be invalid and their requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will no be allowed as an extra, but shall be included in the bid price. Ignorance of any rule, requirement or specification shall not be allowed as an excuse for non-conformity.

Acceptance by the Engineer or Owner does not relieve the contractor from the expense involved for the correction of any errors that may exist on the drawings submitted or in the satisfactory operation of any equipment.

Coordinate electrical equipment and materials installation with other building components. Verify all dimensions by field measurements.

Arrange for chases, slots and openings in other components to allow for electrical installations.

Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

Sequence, coordinate and integrate installation of electrical materials equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning.

Coordinate the cutting and patching to accommodate the installation of electrical equipment and materials.

Where mounting heights are not detailed or dimensioned, install electrical services and overhead equipment to provide the maximum headroom possible.

Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

Coordinate the installation of electrical materials and equipment and structural components.

Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

The Drawings are not intended to serve as working or installation drawings. These drawings are for engineering and general arrangement purposes only. The Contractor shall maintain a record set of drawings showing his own work based on the Drawings. These drawings shall show all details of construction, such as dimensioned equipment and conduit layouts, and similar drawings depicting the construction and installation work performed.

Cutting and Patching:

This Article specifies the cutting and patching of electrical equipment, components, and materials to include removal and legal disposal of selected materials, components and equipment.

Do not endanger or damage installed Work through procedures and processes of cutting and patching.

Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.

No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.

Perform cutting, fitting and patching of electrical equipment and materials required to:

- Uncover work to provide for installation of ill-time work

- Remove and replace defective work

- Remove and replace work not conforming to requirements of the Contract Documents

- Remove samples of installed work as specified for testing

- Install equipment and materials in existing structures

- Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineer observation of concealed work

- Cut, remove to source and make safe and legally dispose of selected electrical equipment, components and materials as indicated, including, but not limited to, removal of electrical items indicated to be removed and items made obsolete by the new Work

- Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.

Electrical Submittals:

The Contractor shall furnish for review of the Engineer six (6) sets of each of the manufacturer's specifications, drawings, operating and maintenance instructions and any other data required to provide a complete description of the equipment being supplied and the construction to be performed. These sets shall be in addition to those required for the Contractor's use. The contractor shall also furnish samples of electrical construction material such as conduit and cable, etc., if instructed to do so by the Engineer.

Installation of materials, or equipment before review and acceptance by the Engineer will be at the Contractor's risk. Equipment or materials installed by the Contractor and not accepted by the Engineer will be removed and replaced at the expense of the Contractor.

The Contractor shall furnish six (6) sets each of detailed shop drawings, including elementary and connection wiring diagrams, in addition to those required for his own use. All wiring diagrams shall bear wire numbers required for his own use. All wiring diagrams shall bear wire numbers using a uniform numbering method so that wiring can be easily followed.

Product Listing:

Prepare listing of major electrical equipment and materials for the project. Provide all information requested.

When two or more items of the same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, and similar items used in Work, except as otherwise indicated.

Provide products that are compatible within systems and other connected items.

Nameplate Data:

Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, Product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances and similar essential data. Locate nameplates in accessible locations.

Delivery, Storage and Handling:

Delivery products and project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage and handling.

Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.

Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for smooth and efficient flow of installations.

Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations; concealed equipment; distribution and branch electrical circuitry; fuse and circuit

breaker size and arrangements; support and hanger details; change orders; concealed control system devices.

Mark specifications to indicate approved substitutions; change orders; actual equipment and materials used.

Operations and Maintenance Data:

Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shutdown and emergency instructions and summer and winter operating instructions.

Servicing instructions and lubrication charts and schedules.

Warranties:

Compile and assemble the warranties specified in Division 16, into a separate set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

Provide complete warranty information for each item to include Product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses and telephone numbers and procedures for filing a claim and obtaining warranty services.

Cleaning:

Clean all light fixtures, lamps and lenses prior to final acceptance. Replace all inoperative lamps.

After completion of the work, the Contractor shall furnish to the Engineer a complete set of Record Drawings "As-Built" reproducible tracings of all electrical construction drawings, such as conduit layouts, interconnection and elementary wiring diagrams. Record drawings furnished upon completion of the work shall be corrected to show any deviations from the drawings.

In addition, the Contractor shall furnish one set of manufacturer's drawings and operating instruction marked to reflect "As-Built" conditions. This data shall also be furnished to the Engineer.

All Record Drawings submitted to the Engineer shall be so marked by ½" high letters as follows "RECORD DRAWING". In addition, the Contractor's name shall appear on the drawings along with the signature of the person who prepared same and the date prepared shall also be affixed thereto.

Guarantee:

The Contractor shall guarantee that all work installed by him is free from any and all defects in workmanship and/or materials, and that all apparatus will develop the capacities and characteristics specified. He further guarantees that if, during a period of one year from the date of the certificate of completion and acceptance of his work, any such defects in workmanship, material or performance appear, such defects will be remedied by him without costs to the Owner.

If, in the opinion of the Engineer, remedial measures are not taken within a reasonable time, the Engineer or the Owner may have defects remedied and such costs charged to the Contractor.

SECTION 16015 - TESTING

The Contractor shall perform such tests as required for all component parts of the completed installation to demonstrate the satisfactory functioning of all equipment and wiring and the adequacy of the entire electrical system. Any equipment or materials that fail under test shall be repaired or replaced and then retested until satisfactory results are obtained, entirely at the expense of the contractor. The Contractor shall assume full responsibility for the proper functioning and quality of the entire electrical installation to the extent that any breakdowns, deficiencies or deteriorations caused by poor workmanship, equipment, materials or method of installation shall be promptly remedied, replaced or repaired by the contractor. Any corrections required during the guarantee period and established following a survey of the installation at the end of the guarantee period shall be modified as above. The terms of the guarantee are stipulated elsewhere in these specifications.

The contractor shall furnish all instruments with a qualified Technician from an outside testing firm to properly perform all tests required. Written notice of all tests shall be given the Engineer at least ten (10) working days in advance.

Unless waived in writing by the Engineer, all tests shall be made in the presence of a duly authorized representative of the Engineer. When the presence of such representative is so waived, sworn statements, in duplicate, of the tests made and the results thereof, shall be furnished to the Engineer by the Contractor.

Cost of all tests shall be borne by the Contractor and shall be included in the Contract bid price.

All electrical circuits shall be tested to insure circuit continuity, insulation resistance, proper splicing and freedom from improper grounds.

All connections to be infrared tested after energizing and again after one month of carrying actual loads.

Necessary adjustment shall be made in cooperation with the manufacturer and other contractors when necessary. All tests shall be made in accordance with the latest standards of the ANSI.

"Megger" tests of insulation resistance on all new rotating machines shall be conducted. The results will be accepted when a Megger shows the insulation resistance to be not less than one megohm per 100 volts at 20°C. Utilize a 1,000V megger for equipment rated 600V or less. All motors shall be properly connected to protective devices and controls.

"Megger" tests of the insulation resistance of all power feeders shall be conducted. The results will be accepted when the megger shows the insulation resistance to be not less than one megohm per 100 volts at 20°C using a megger. Utilize a 1000V megger for cables rated 600V. Test reports shall indicate date, weather conditions, cable size, length of run and resistance observed on a per conductor basis. Test shall be conducted phase to phase, phase to neutral and phase to ground for all feeders and branch circuits.

Test results shall be given in "Ohms" at 20°C ambient. All tests and resistance readings shall be made per the applicable ANSI Standards that apply.

The grounding system shall have a resistance to ground of ten (10) ohms or less when measured by a fall of potential ground resistance test, I.E.E.E. Standard No. 81, Section 9.04. Two (2) additional reference ground rods must be driven away from the ground under test. The ground under test and the reference ground rods shall be connected to the test instrument with insulated lead wires. Tests shall not be conducted when the soil within a 10-foot radius of the ground under test is water logged or has been subjected to chemical additives.

Before energizing any motor, the overload heaters and relays shall be checked for manufacturer recommendations based on actual motor nameplate full load current. Motor voltage requirements shall also be confirmed.

All motors shall be properly connected to protective devices and controls to give proper motor acceleration and correct motor rotation. The control wiring shall be properly interconnected to all the control devices associated with a machine, a group of machines, or the device to produce the correct operation, timing and/or sequencing of the equipment.

The equipment shall then be given an operational test to determine that all components including motors, controls protective and switching devices and auxiliary associated equipment are in an operable condition and can function as described and shown on relevant specifications, operating instructions and drawings.

Motor currents shall be recorded and the Engineer shall be advised as soon as possible of any unbalance or value above 5% of nameplate full load. Overload heater ratings or relay settings shall not be increased in size or setting if trip occurs. The Engineer shall be informed of such trips and the contractor shall be advised accordingly.

The Contractor for review and record purposes shall forward Four (4) copies each of all test results to the Engineer.

No equipment shall be energized until all tests and adjustments have been made to the satisfaction of the Engineer and the Owner.

The Engineer shall witness tests. The cause of any failure shall be impartially examined by the Engineer and the results shall be binding on the Contractor, if in the Engineer's judgment such failure was caused by poor workmanship, materials and/or equipment provided by the Contractor.

SECTION 16110 - RACEWAYS

NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to electric raceway systems; and provide products and components that have been UL-listed and labeled.

NEC Compliance: Comply with NEC requirements as applicable to construction and installation of raceway systems.

Conduit and Tubing:

General: Provide metal and nonmetallic conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.

Rigid Metal Conduit: Provide rigid steel, zinc-coated, threaded type conforming to FS WW-C-581, ANSI C80.1 and UL 6. Provide zinc coating fused to inside and outside walls,

Intermediate Steel Conduit: Rigid intermediate grade (IMC) hot- dip galvanized conforming to FS WW-C-581 and UL 1242.

Rigid Metal Conduit Fittings: Cast malleable iron, galvanized or cadmium plated, conforming to FS W-F-408. Use Type 1 fittings for rain tight connections, Type 2 fittings for concrete tight connections, and Type 3 fittings for other miscellaneous connections.

Electrical Metallic Tubing (EMT): FS WW-C-563, ANSI C80.3 and UL 797.

EMT Fittings: FS W-F-408.

Use Type 1 fittings for rain tight connections.

Use Type 2 fittings for concrete tight connections.

Use Type 3 fittings for miscellaneous connections.

Flexible Metal Conduit: FS WW-C-566 and UL 1. Formed from continuous length of spirally wound, interlocked zinc-coated strip steel.

Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.

Straight Terminal Connectors: One-piece body, with female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

45° or 90° Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit and male threaded and provided with locknut.

Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; constructed of single strip, flexible, continuous, interlocked and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).

Electrical Plastic Conduit

Heavy Wall Conduit: Schedule 40, 90, UL rated, constructed of PVC and conforming to NEMA TC-2, for direct burial, or normal above ground use, UL listed and in conformity with NEC Article 347.

Extra Heavy Wall Conduit: Schedule 80, UL rated, constructed of PVC compound C-200 PVC, and UL listed in accordance with NEC Article 347 for direct burial or above ground use.

Thin Wall Conduit: Type A, UL rated for concrete encasement underground, constructed of PVC compound C-2000, and UL listed in accordance with NEC Article 347.

Conduit and Tubing Accessories: provide conduit, and tubing accessories of types, sizes and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

Conduit Bodies: Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded conduit entrance ends, removable covers, either cast or of galvanized steel and corrosion-resistant screws.

Manufacturers: Provide conduit bodies of one of the following:

Appleton Electric; Div of Emerson Electric Co.
 Arrow-Hart Div; Crouse-Hinds Co.
 Bell Electric Div; Square D Co.
 Gould, Inc.
 O/Z Gedney Div; General Signal Co.
 Spring City Electrical Mfg. Co.

Wireways:

General: Provide electrical wireways of types, grades, sizes and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps and other components and accessories as required for complete system.

Lay-In Wireways: Construct lay-in wireways with hinged covers, in accordance with UL 870 and with components UL listed, including lengths, connectors and fittings. Design units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors. Construct units to be capable of sealing cover in closed position with sealing wire. Provide wireways with knockouts.

Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached that removal is not necessary to utilize the lay-in feature.

Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

Raintight Troughs: Construct in accordance with UL 870, with components UL listed.

Construction: 16 gauge galvanized sheet metal parts for 4"x4" to 6"x6" sections, and 14-gauge parts for 8"x7" and larger sections. Provide knockouts only in bottom of troughs, with suitable adapters to facilitate attaching to other NEMA 3R enclosures. Do not use gasketing that can rip or tear during installation, or would compromise raintight capability of the trough. Do not use cover screws that will protrude into the trough area and damage wire insulation.

Finish: Provide 14 gauge and 16 gauge galvanized sheet metal parts with corrosion-resistant phosphate primer and baked enamel finish. Plate hardware to prevent corrosion.

Conduits: Install concealed conduits in new construction work, either in walls or slabs. Run concealed conduits in existing work where practicable.

Use rigid steel zinc coated conduit where embedded in concrete, masonry, earth, or installed outdoors.

Use rigid steel zinc coated conduit in mechanical equipment rooms, electrical equipment rooms, penthouses, crawl spaces, service splines, ceiling plenum areas, kitchens or cafeterias and warehouse spaces below 18'-0" height and for main feeder circuits.

Use steel zinc coated EMT in offices, corridors, toilets, lunchroom areas, lab areas, and warehouse spaces above 18'-0" height.

Use flexible conduit in moveable partitions and from outlet boxes to recessed lighting fixtures and final 24" of connection to motors or control items subject to movement or vibration and in cells of precast concrete panels.

Use liquid-tight flexible conduit where subjected to one or more of the following conditions:

Exterior location
 Moist or humid atmosphere where condensate can be expected to accumulate

Corrosive atmosphere
 Subjected to water spray or dripping oil, water or grease

Surface Raceways and Wireways: Mechanically assemble metal enclosures and raceways to form continuous electrical conductor and connect to electrical boxes, fittings and cabinet as to provide effective electrical continuity and rigid mechanical assembly.

Where practicable, avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.

Install expansion fittings in all raceways wherever structural expansion joints are crossed.

Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. Field bends of raceway sections are not permitted.

Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.

Use boxes as supplied by raceway manufacturer wherever junction, pull or devices boxes are required. Standard electrical "handy" boxes, etc., are not to be permitted for use with surface raceway installations.

SECTION 16120 - WIRES AND CABLES

NEC Compliance: Comply with applicable requirements of NEC for construction and installation of wires/cables and connectors.

UL Compliance: Comply with UL Stds 83 and 486A. Provide wiring/cabling and connector products that are UL listed and labeled.

NEMA/ICEA Compliance: Comply with NEMA/ICEA Stds Pub/No.'s WC-5 and WC-30.

IEEE Compliance: Comply with IEEE Stds 82 and 241 pertaining to wiring systems.

ASTM Compliance: Comply with ASTM B1, 2, 3, 8 and D-753. Provide copper conductors with conductivity of not less than 98% at 20 deg. C (68 deg. F).

FS Compliance: Comply with FS J-C-30 and W-S-610.

Manufacturers: Provide wire/cable products of one of the following (for each type of wire/cable and connectors):

Wire and Cable:	Apex Wire and Cable Corp. American Insulated Wire Corp American Wire and Cable Co. Anaconda-Ericsson Inc.; Wire and Cable Div. Belden Div; Cooper Industries Brand-Rex Div; Pyle National Co. Cerro Wire and Cable Corp. Cleveland Insulated Wire Co. General Cable Corp.	Helix Wire Corp. Hitemp Wires, Inc. Indiana Insulated Wire, Inc. Madison Wire and Cable Corp. Phelps Dodge Cable & Wire Co. Pirelli Cable Corp. Radix Wire Co. Rome Cable Corp. Southwire Company Triangle PWC, Inc.
Connectors:	AMP, Inc. Appleton Electric Co.; Emerson Electric Co. Burndy Corp. Brand-Rex Div; Pyle National Co. Electrical Products Div; Midland-Ross Corp. General Electric Co. Gould Inc.	Ideal Industries, Inc. Leviton Mfg. Co. 3M Company OZ/Gedney Co. Southport Industries, Inc. Square D Company Thomas and Betts Corp.

General: Provide electrical wires, cables and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for applications indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20 deg. C (68 deg. F).

Building Wires: Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Select from the following UL types, those wires which construction features that fulfill project requirements.

Type RHH: For dry locations, max. Operating temperature 90 deg. C (194 deg. F). Insulation, heat resistant rubber, outer covering, moisture-resistant, flame retardant, nonmetallic covering, conductor, annealed copper.

Type RHW: For dry and wet locations; max. Operating temperature 75 deg. C (167 deg. F). Insulation, moisture and heat resistant rubber; outer covering, moisture resistant, flame retardant, nonmetallic covering; conductor, annealed copper.

Type RUH: For dry locations; max. Operating temperature 75 deg. C (167 deg. F). Insulation, 90% unmilled, grainless rubber; outer covering, moisture resistant, flame retardant, nonmetallic covering; conductor, annealed copper.

Type RUW: For wet and dry locations; max. Operating temperature 60 deg. C (120 deg. F). Insulation, 90% unmilled, grainless rubber; outer covering, moisture resistant, flame retardant, nonmetallic covering; conductor, annealed copper.

Type THW: For dry and wet locations; max. Operating temperature 75 deg. C (167 deg. F). Insulation, flame retardant, moisture and heat resistant, thermoplastic; conductor, annealed copper.

Type THWN: For dry and wet locations; max. Operating temperature 75 deg. C (167 deg. F). Insulation, flame retardant, moisture and heat resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.

Type TW: For dry and wet locations; max. Operating temperature 60 deg. C (140 deg. F). Insulation, flame retardant, moisture resistant thermoplastic, conductor, annealed copper.

Type XHHW: For dry locations; max. Operating temperature 90 deg. C (194 deg. F). Insulation, flame retardant, cross-linked synthetic polymer; conductor, annealed copper.

Type TBS: For switchboard wiring only; max. Operating temperature 90 deg. C (194 deg. F). Insulation, thermoplastic; outer covering, flame retardant, nonmetallic covering; conductor, annealed copper.

Type MI: For wet and dry locations; max. Operating temperature 85 deg. C (185 deg. F). Insulation, magnesium oxide; outer covering, copper sheath; conductor, annealed copper.

Cables: Provide UL-Type factory fabricated cables of sizes, ampacity ratings, materials and jacketing/sheathing as indicated for services indicated. Select from the following types, those cables with construction features that fulfill project requirements:

Type MI: Mineral insulated, metal sheathed (copper) cable; used for services, feeders and branch circuits in hazardous locations; underground, indoors or outdoors. No used where exposed to destructive corrosive conditions.

Type MC: Metal clad cable; used for wet or dry locations; exposed or concealed; suitable for cable tray usage.

Type AC: Armored cable; used in dry locations for under-plaster extensions. Not for direct burial in earth.

Type SNM: Shielded nonmetallic sheathed cable; used in cable trays or in other raceways, and for hazardous conditions.

Type SE: Service entrance cable for above ground installation; flame retardant, moisture resistant.

Type USE: Service entrance cable for underground installation; moisture resistant, but does not have flame retardant covering.

Type UF: Underground feeder, metallic and nonmetallic armored types for direct burial; also used for interior wiring in wet, dry and corrosive locations.

NOTE: SPECIAL CABLE TYPES FOR PROJECT INDICATED ON DRAWING.

Connectors:

General: Provide UL type factory fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following, those types, classes, kinds and styles of connectors to fulfill project requirements:

Type: Pressure

Type: Crimp

Type: Threaded

Class: Insulated

Class: Non-Insulated

Kind: Copper (for Cu to Cu connection)

Kind: Aluminum-Copper (for Al to Cu connection)

Style: Butt connection

Style: Elbow connection

Style: Combined "T" and straight connection

Style: "T" connection

Style: Split bolt parallel connection

Style: Tap connection

Style: Pigtail connection

Style: Wirenut connection

Installation:

Install cables, wires and wiring connectors as indicated, in accordance with recognized industry installation practices. Comply with applicable requirements of NEC, UL and NEMA standards and with NECA's "Standard of Installation".

Coordinate wire/cable work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables with other work.

Install UL Type UF cable with nonmetallic outer jacketing, for underground feeders.

Install UL Type THW wiring in conduit for feeders and branch circuits.

Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening requirements. If not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.

Prior to energization, test wires and cables for continuity of circuitry, insulation resistance and for short circuits. Correct malfunctions when detected.

Subsequent to wire/cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Correct malfunctions, if any, and retest.

SECTION 16135 - ELECTRICAL BOXES AND FITTINGS

NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.

NEC ARTICLE 370 APPLIES ABOVE.

UL Compliance: Comply with UL Std. Nos. 50, 514 series and 886. Provide electrical boxes and fittings which are UL listed and labeled.

NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2 and Pub 250.

Federal Specification Compliance: COMPLY with applicable requirements of FS W-C-586, "Electrical Cast Metal Conduit Outlet Boxes, Bodies and Entrance Caps".

Fabricated Materials:

Outlet Boxes: Provide galvanized coated flat rolled sheet steel Outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct Outlet boxes with mounting holes, and with cable and conduit size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion resistant cover and grounding screws for fastening surface and device type box covers and for equipment type grounding.

OUTLET Box Accessories: PROVIDE Outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting Outlet boxes, which are compatible with Outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code compliance option.

Device Boxes: Provide galvanized coated flat rolled sheet steel non-gangable device boxes of shapes, cubic inch capacities and sizes, including box depths as indicated, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with cable size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide cable clamps and corrosion-resistant screws for fastening cable clamps, and for equipment type grounding.

Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code compliance option.

Manufacturers: PROVIDE interior Outlet boxes of one of the following (for each type interior box):

Adalet-PLM Div, Scott Fetzer Co.
 Appleton Electric; Emerson Electric Co.
 Bell Electric; Square D Company
 Eagle Electric Mfg. Co., Inc.
 Midland-Ross Corp.
 OZ/Gedney; General Signal Co.
 Pass and Seymour, Inc.
 RACO Div; Harvey Hubbell Inc.
 Thomas & Betts Co.

Raintight Outlet Boxes: Provide corrosion-resistant cast metal raintight Outlet wiring boxes, of types, shapes and sizes, including depth of boxes with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.

Manufacturers: Provide raintight Outlet boxes on one of the following:

Appleton Electric; Emerson Electric Co.
 Arrow-Hart Div; Crouse-Hinds Co.
 Bell Electric; Square D Company
 Eagle Electric Mfg. Co., Inc.
 Gould, Inc.
 Harvey Hubbell, Inc.
 OZ/Gedney; General Signal Co.
 Pass and Seymour, Inc.

Junction and Pull Boxes: Provide galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

Manufacturers: Provide junction and pull boxes of one of the following (for each type junction and pull box):

Adalet-PLM Div, Scott Fetzer Co.
 Appleton Electric; Emerson Electric Co.
 Arrow-Hart Div; Crouse-Hinds Co.
 Bell Electric; Square D Company

GTE Corporation
 Keystone Columbia, Inc.
 OZ/Gedney; General Signal Co.
 Spring City Electrical Mfg. Co.

Floor Boxes: Provide cast-iron raintight adjustable floor boxes as indicated, with threaded-conduit-entrance ends, and vertical adjusting rings, gaskets, brass floor plates with flush screw-on covers with ground flange and stainless steel cover screws.

Poke-Throughs: Provide factory pre-wired poke-through units, suitable for power and communication work, with UL fire resistance rating of three hours. Construct integral fire-stop with cold smoke barrier to prevent passage of smoke where heat is not present.

Manufacturers: Provide floor boxes of one of the following (for each type floor box):

Arrow-Hart Div; Crouse-Hinds Co.
 Harvey Hubbell, Inc.
 Midland-Ross Corp.
 Nelson Electric; General Signal Co.
 Pyle-National Co.
 Spring City Electrical Mfg. Co.
 Square D. Company

Bushings, Knockout Closures and Locknuts: Provide corrosion resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

Manufacturers: Provide bushings, knockout closures, locknuts and connectors of one of the following:

Adalet-PLM Div; Scott Fetzer Co.
 AMP, Inc.
 Arrow-Hart Div; Crouse-Hinds Co.
 Appleton Electric Co.; Emerson Electric Co.
 Bell Electric; Square D Co.
 Midland-Ross Corp.
 Midwest Electric; Cooper Industries, Inc.
 OZ/Gedney Co.; General Signal Co.
 RACO Div; Harvey Hubbell Inc.
 Thomas & Betts Co., Inc.

Installation:

Install

Electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

Provide weather tight outlets for interior and exterior locations exposed to weather or moisture.

Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

Avoid installing aluminum products in concrete.

Position recessed Outlet boxes accurately to allow for surface finish thickness.

Set floor boxes level and flush with finish flooring material.

Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

BOX SUPPORT MUST BE INDEPENDENT OF CONDUIT.

Provide electrical connections for installed boxes.

Ground electrical boxes properly upon completion of installation work and demonstrate compliance with requirements.

SECTION 16142 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

NEC Compliance: Comply with applicable requirements of NEC.

UL Compliance: Comply with UL Std 486A. Provide electrical connection products and materials that are UL-listed and labeled.

ANSI Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections.

IEEE Compliance: Comply with requirements of Std 241 pertaining to connectors and terminations.

Manufacturers: Provide connection products of one of the following (for each type of connector):

Adalet-PLM Div, Scott and Fetzer Co.
 Allen-Stevens Conduit Fittings Corp.
 AMP Incorporated
 Appleton Electric Co.
 Arrow-Hart Div, Crouse-Hinds Co.
 Atlas Technologies, Inc.
 Bishop Div, General Signal Corp.
 Burndy Corporation
 Eagle Electric Mfg Co., Inc.
 Electroline Mfg Co.
 Gardner Bender, Inc.
 General Electric Co.
 Gould, Inc.
 Harvey Hubbell Inc.
 Ideal Industries, Inc.
 Pyle National Co.
 Reliable Electric Co.
 Square D Company
 Thomas and Betts Corp.

General: For each electrical connection indicated, provide complete assembly of materials, including pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solder less wirenuts, and other items and accessories as needed to complete splices and terminations of types indicated.

Materials:

Raceways: Provide metal conduit and tubing complying with Division 16 Basic Electrical Materials and Methods section, "Raceways".

General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements; and comply with NEC requirements for raceways.

Rigid Aluminum Conduit: FS WW-C-540 and ANSI C80.5.

Rigid Steel Conduit: FS WW-C-581 and ANSI C80.1.

PVC Externally Coated Rigid Steel Conduit: ANSI C80.1 and NEMA Std Pub No. RN 1.

Rigid Metal Conduit Fittings: FS W-F-408.

Electrical Metallic Tubing (EMT): FS WW-C-563 and ANSI C80.3.

PVC Externally Coated Electrical Metallic Tubing (EMT): ANSI C80.3 and NEMA Std Pub No. RN 1.

EMT Fittings: FS W-F-408.

Flexible Metal Conduit: FS WW-C-566 of the following type:

Type I: Aluminum

Type II: Zinc-coated steel

Flexible Metal Conduit Fittings: FS W-F-406.

Liquid-tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit comprised of single strip, continuous, flexible, interlocked, double-wrapped steel, galvanized inside and outside; forming smooth internal wiring channel; with liquid-tight jacket of flexible polyvinyl chloride (PVC).

Liquid-tight Flexible Metal Conduit Fittings: FS W-F-406.

Wires/Cables: Provide wires, cables and conductors complying with Division 16 Basic Electrical Materials and Methods section, "Wires and Cables". Unless otherwise indicated, provide wires, cables and conductors for electrical connections that match, including sizes and ratings, wires, cables and conductors of those supplying power to equipment. Provide copper conductors with conductivity of not less than 98% at 20 deg. C (68 deg. F).

Connectors and Terminals: Provide electrical connectors and terminals that mate and match, including sizes and ratings, and are recommended by equipment manufacturer for intended applications.

Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, cable ties, wire nuts, lugs and clamps as recommended for use by accessories manufacturers for type services indicated.

Installation:

Install electrical connections as indicated, in accordance with connector manufacturer's written instructions and wiring diagrams, and complying with UL, NEC and NECA's "Standard of Installation".

Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment, wherever possible.

Maintain existing electrical service and feeders and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer.

Cover splices with electrical insulation material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

Trim cables and wires to be short as practicable and arrange routing to facilitate inspection, testing and maintenance.

Provide PVC coated conduit and fittings for highly corrosive atmospheres as indicated.

Provide flexible conduit for motor connections, and for other electrical equipment connections where subject to movement and vibration.

Tighten connectors and terminals, including screws and bolts in accordance with equipment manufacturers published torque-tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division 16 section "Electrical Identification". Affix markers on each terminal conductor, as close as possible to the point of connection.

Test electrical connections to demonstrate capability and compliance with requirements upon completion of installation of connections. Ensure that phase of rotation fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

SECTION 16143 - WIRING DEVICES

NEC Compliance: Comply with NEC as applicable to installation and wiring of electrical wiring devices.

UL Compliance: Comply with applicable requirements of UL 20, 486A, 498 and 943 pertaining to installation of wiring devices. Provide wiring devices which are UL listed and labeled.

IEEE Compliance: Comply with applicable requirements of IEEE Std 241, "Recommended Practice for Electric Power Systems in Commercial Buildings", pertaining to electrical wiring systems.

Manufacturers: Provide products of one of the following (for each type and rating of wiring device):

Adalet-PLM Div, Scott and Fetzer Co.
 Allen-Bradley
 AMP Incorporated
 Appleton Electric Co.
 Arrow-Hart Div, Crouse-Hinds Co.
 Bryant Electric Co.
 Culter-Hammer, inc.
 Eagle Electric Mfg Co., Inc.
 Furnas Electric Co.
 General Electric Co.
 GTE Products Corp.
 Harvey Hubbell Inc.
 Ideal Industries, Inc.
 Leviton Mfg. Co.
 Pass and Seymour Inc.
 Slater Electric Company
 Square D Company
 Thomas and Betts Corp.
 Warker Parkersburg Div; Textron Inc.
 Wiremold Company

General: Provide factory-fabricated wiring devices, in types, colors and electrical ratings for applications indicated and which comply with NEMA Stds Pub/No. WD 1. Provide brown color devices and wall plates except as otherwise indicated; color selection to be verified by contractor with Architect/Engineer.

Receptacles:

General-Duty Duplex: Provide duplex general-duty type receptacles, 2-pole, 3-wire, grounding, with green hexagonal equipment ground screw, ground terminals and poles integrally connected to mounting yoke, 15 amperes, 125 volts with metal plaster ears; design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-15R unless otherwise indicated.

General-Duty Simplex: Provide single general-duty type receptacles, 2-pole, 3-wire, grounding, with green hexagonal equipment ground screw, 20-amperes, 125-volts with metal plaster ears; design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-20R unless otherwise indicated.

Heavy-Duty Duplex: Provide heavy-duty duplex receptacles, 2-pole, 3-wire, grounding, 15-amperes, 125-volts, with metal plaster ears, design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-15R unless otherwise indicated.

Ground-Fault Circuit Interrupters: Provide "feed thru" type ground-fault circuit interrupters, with heavy duty duplex receptacles, capable of protecting connected downstream receptacles on single circuit, and of being installed in a 2¾" deep outlet box without adapter, grounding type UL rated Class A, Group 1, rated 20-amperes, 120 volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliamperes ground-fault trip level; equip with NEMA configuration 5-15R.

Plugs and Connectors:

Plugs: Provide 15-amperes, 125-volts, 3-wire, grounding, armored cap plugs, parallel blades with cord clamp and 0.4" cord hole; match NEMA configuration with power sources.

Connectors: Provide 15-amperes, 125-volts, bakelite-body armored connectors, 3-wire, grounding, parallel blades, double wipe contact, with cord lamp, and 0.4" cord hole, match NEMA configuration to mating plug's.

Switches:

Snap: Provide general duty flush single pole toggle switches, 15 amperes, 120/277 volts AC, with mounting yoke insulated from mechanism, equip with plaster ears, switch handle, and side wired screw terminals.

Duplex Snap: Provide general duty flush double pole AC quiet switches, 15 amperes, 120/277 volts, with mounting yoke insulated from mechanism, equip with plaster ears, switch handles, side wired screw terminals with break off tab features, which allows wiring with separate or common feed.

Three Way: Provide general duty flush 3-way AC switches, 15 amperes, 120/277 volts, with mounting yoke insulated from mechanism, equip with plaster ears, lock type switch handles, side wired screw terminals, with break off tab features, which allows wiring with separate or common feed.

Four Way: Provide general duty flush 4-way AC quiet switches, 15 amperes, 120/277 volts, with mounting yoke insulated from mechanism, equip with plaster ears, switch handles, side wired screw terminals, with break off tab features, which allows wiring with separate or common feed.

Touch Snap: Provide soft touch snap switches, capable of effortless fingertip operation; single pole AC quiet, with lighted rocker switch handles; side wire screw terminals for connecting copper clad aluminum wire, 20 amperes, 120/277 volts rating, equip with plaster ears.

Combination Devices: Provide general duty 3-way quiet switch, 20 amperes, 120/277 volts AC, with toggle switch handle, and 3-wire grounding receptacle, 20 amperes, 120 volts, equip with plaster ears, and with break off tab feature which allows wiring with separate or common feed, with NEMA configuration 5-20R.

Wiring Device Accessories:

Wall Plates: Provide wall plates for single and combination wiring devices, of types, sizes and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish to plates; wall plates colored to match wiring devices. Provide plates possessing the following additional construction features:

Material and Finish:	Steel plate with wrinkled finish, baked-on white insulating enamel
Material and Finish:	0.04" thick type 302 satin finished stainless steel
Material and Finish:	0.04" thick brass, brushed
Material and Finish:	0.04" thick brass, satin chrome plated
Material and Finish:	0.05" thick aluminum, anodized
Material and Finish:	Steel plate, galvanized
Material and Finish:	Plastic, ribbed
Material and Finish:	Plastic, smooth

Installation:

Install wiring devices as indicated, in accordance with manufacturer's written instructions and applicable requirements of NEC and NECAs "Standard of Installation".

Install wiring devices after wiring work is completed.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A and B. Use properly scaled torque indicating hand tool.

Testing: Prior to energizing circuitry, test wiring for electrical continuity, and for short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

SECTION 16170 - CIRCUIT AND MOTOR DISCONNECTS

NEC Compliance: Comply with NEC requirements pertaining to construction and installation of electrical circuit and motor disconnect devices.

ARTICLE 430, ET AL., APPLIES ABOVE

UL Compliance: Comply with requirements of UL 98 "Enclosed and Dead Front Switches". Provide circuit and motor disconnect switches which have been UL listed and labeled.

NEMA Compliance: Comply with applicable requirements of NEMA Stds Pub No. KS 1, "Enclosed Switches".

Manufacturers: Provide disconnect products of one of the following (for each type of device):

Crouse-Hinds Co.
Culter-Hammer, inc.
Federal pacific Electric Co.
Furnas Electric Co.
General Electric Co.
General Switch Corp.
GTE Sylvania Inc.
Square D Company
Westinghouse Electric Corp.

Fabricated Switches:

General Duty Disconnect Switches: Provide surface mounted, general duty type, sheet steel enclosed switches, of types, sizes and electrical characteristics indicated; rated 240 volts, 200 amperes, 60 Hz, with 3-blades, 3-poles; and incorporating spring assisted, quick-make, quick break switches which are so constructed that switch blades are visible in OFF position with door open. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable, and is capable of being padlocked in OFF position. Construct current carrying parts of high-conductivity copper, with silver tungsten type switch contacts, and stamped enclosure knockouts. Provide NEMA Type 1 enclosure.

Heavy Duty Safety Switches: Provide surface mounted, heavy duty type, sheet steel enclosed safety switches, of types, sizes and electrical characteristics indicated; fusible type, rated 600 volts, 400 amperes, 60 Hz, 3-blades, 4-poles solid neutral; and incorporating quick make, quick break type switches; construct so that switch blades are visible in OFF position with door open. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable, and is padlockable in OFF position; construct current carrying parts of high conductivity copper, with silver tungsten type switch contacts, and positive pressure type reinforced fuse clips provide NEMA Type 3R enclosure.

Fuses: Provide fuses for safety switches, as recommended by switch manufacturer, of classes, types and ratings needed to fulfill electrical requirements for service indicated.

Installation:

Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA and NECA's "Standard of Installation" and in accordance with recognized industry practices.

Coordinate circuit and motor disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

Install disconnect switches for use with motor driven appliances, and motors and controller within sight of controller position unless otherwise indicated.

SECTION 16190 - SUPPORTING DEVICES

NEC Compliance: Comply with NEC as applicable to construction and installation of electrical supporting devices.

MSS Compliance: Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe/conduit hangars and supports.

NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.

UL Compliance: Provide electrical components and devices which are UL listed and labeled.

FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining strap for conduit, pipe and cable.

Manufactured Supporting Devices:

General: Provide supporting devices that comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of device fulfills indicated requirements, selection is Installer's option.

Supports: Provide supporting devices of types, sizes and materials indicated; and have the following construction features:

Clevis Hangers: For supporting 3" rigid metal conduit; galvanized steel with 1/2" diameter hole for round steel rod; approximately 54 pounds per 100 units.

Riser Clamps: For supporting 5" rigid metal conduit; black steel; with 2 bolts and nuts, and 4" ears; approximately 510 pounds per 100 units.

Reducing Couplings: Steel rod reducing coupling, 1/2" x 5/8"; black steel; approximately 16 pounds per 100 units.

C-Clamps: Black malleable iron; 1/2" rod size; approximately 70 pounds per 100 units.

I-Beam Clamps: Black steel, 1 1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 pounds per 100 units.

One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.

Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; 3/4" strap width; and 2_ " between center of screw holes.

Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 pounds per 100 units.

Round Steel Rod: black steel; 1/2" diameter; approximately 67 pounds per 100 feet.

Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.

Anchors: Provide anchors of types, sizes and materials indicated; and having the following construction features:

Lead Expansion Anchors: 1/2"; approximately 38 pounds per 100 units.

Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 pounds per 100 units.

Manufacturers: Provide anchors of one of the following (for each type of anchor):

Abbeon Cal Inc.

Ackerman Johnson Fastening Systems Inc.

Elcen Metal Products Co.

Ideal Industries, Inc.

Joslyn Mfg and supply Co.

McGraw Edison Co.

Rawlplug Co., Inc.
 Star Expansion co.
 U.S. Expansion Bolt Co.

Sleeves and Seals: Provide sleeves and seals, including armored cable seals, of types, sizes and materials indicated, with the following construction features:

Wall and Floor Seals: Provide factory assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps and cap screws.

Conduit Cable Supports: Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct for 2" rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable iron casting with hot-dip galvanized finish.

U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 12-gage hot-dip galvanized steel, of types and sizes indicated; construct with 9/16" holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:

Fixture hangers
 Channel hangers
 End caps
 Beam clamps
 Wiring studs
 Thin wall conduit clamps
 Rigid conduit clamps
 Conduit hangers
 U-bolts

Manufacturers: Provide U-channel strut systems of one of the following (for each type system):

Allied Tube and Conduit Corp.
 B-Line Systems, Inc.
 Elcen Metal Products co.
 Greenfield Mfg. Co., Inc.
 Midland-Ross Corp.
 OZ/Gedney Div; General Signal Corp.
 Power-strut Div.; Van Huffel Tube Corp.
 Unistrut Div.; GTE Products Corp.

Fabricated Supporting Devices:

Pipe Sleeves: Provide pipe sleeves of one of the following:

Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams or welded longitudinal joint. Fabricate sleeves from the following gage metal: 3" and smaller, 20-gage; 4" to 6", 16-gage; over 6", 14-gage.

Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

Iron Pipe: Fabricate from cast-iron or ductile iron pipe; remove burrs.

Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.

Sleeve Seals: Provide sleeves for piping which penetrates foundation walls below grade, or exterior walls. Caulk between sleeve and pipe with non-toxic, UL classified caulking material to ensure water-tight seal.

Installation:

Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices. Comply with installation requirements of NECA and NEC pertaining to supporting devices.

Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacings indicated and in compliance with NEC requirements.

Torque sleeve seal nuts, complying with manufacturer's recommended torquing values. Ensure sealing grommets expand to form watertight seal.

SECTION 16195 - ELECTRICAL IDENTIFICATION

UL Compliance: Comply with UL Std 969.

NEC and NEMA Compliance: Comply with NEC and NEMA No.'s WC-1 and WC-2.

ANSI Compliance: Comply with ANSI Std A13.1.

Manufacturer: Provide electrical identification products of one of the following (for each type marker):

Alarm Supply Co., Inc.
Brady, W.H. Co.
Calpico Inc.
Cole-Flex Corp.
Direct Safety Co.
George-Ingraham Corp.
Griffolyn Company
Ideal Industries, Inc.
LEM Products, inc.
Markal Company
National Band and Tag Co.
Panduit Corp.
Radar Engineers Div.; EPIC Corp.
Seton Name Plate Co.
Tesa Corp.

General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

Colored-Coded Conduit Markers: Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive, adhesive lap joint of marker, matching adhesive plastic tape at each end of marker, or pre-tensioned snap-on. Except as otherwise indicated, provide lettering that indicates voltage of conductor(s) in conduit. Provide 8" minimum length for 2" and smaller conduit, 12" length for larger conduit.

Colors: Unless otherwise indicated or required by governing regulation, provide white markers with black letters.

Color Coded Plastic Tape: Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1½" wide.

Colors: Unless otherwise indicated, or required by governing regulations, provide orange tape.

Underground Type Plastic Line Marker: Manufacturer's standard permanent, bright colored, continuous printed plastic tape, intended for direct burial service, not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable.

Cable/Conductor Identification Bands: Provide manufacturer's standard aluminum wrap around cable/conductor markers of size required for proper application, and numbered to show circuit identification.

Plasticized Tags: Manufacturer's standard preprinted or partially preprinted accident prevention and operational tags, of plasticized card stock with matte finish suitable for writing, approximately 3¼" x 5", with brass grommets

and wire fasteners and with appropriate preprinted wording including large size primary wording, e.g. DANGER, CAUTION, DO NOT OPERATE.

Self-Adhesive Plastic Signs: Provide manufacturer's standard, self-adhesive or pressure sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g. 208V, EXHAUST FAN, RECTIFIER.

Colors: Unless otherwise indicated, or required by governing regulations, provide white signs with black lettering.

Baked Enamel Danger Signs: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gauge steel; of standard red, black and white graphics; 14"x10" size except where 10"x7" is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g. HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

Engraved Plastic-Laminate Signs: Provide engraving stock melamine plastic laminate with black face and white core plies (letter color), complying with FS L-P-387, in sizes and thicknesses indicated. Engrave laminate with engraver's standard letter style of sizes and wording indicated, and punch for mechanical fastening except where adhesive mounting is necessary because of substrate.

Thickness: 1/8", except as otherwise indicated.

Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

Lettering and Graphics: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

Installation:

Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.

Coordination: Where identification is to be applied to surfaces that require finish, install identification after completion of painting.

Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

Conduit Identification: Where electrical conduit is exposed in spaces with exposed mechanical piping that is identified by color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated, use white as coded color for conduit.

Underground Cable Identification: During backfilling/topsoiling of each exterior underground electrical, signal or communication cable, install continuous underground type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.

Install line marker for every buried cable, regardless of whether direct buried or protected in conduit.

Cable/Conductor Identification: Apply cable conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except when another form of identification (such as color coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents and similar previously established identification for project's electrical work.

Operational Identification and Warnings: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification instruction or warnings on switches, outlets and other controls,

devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

Danger Signs: In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.

High Voltage: Install danger signs where it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.

Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

Equipment/System Identification: Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, ½" high lettering on 1½" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work. All circuits shall be identified on panel door schedules. All circuits shall be identified on panel door schedules.

Panelboards, electrical cabinets and enclosures.

Access panel/doors to electrical facilities.

Major electrical switchgear.

Electrical substations.

Power transfer equipment.

Transformers.

Battery racks.

Install signs at locations indicated, or where not otherwise indicated, at location of best convenience of viewing without interference with operation and maintenance equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate.

SECTION 16223 – ELECTRICAL SERVICE

NEC Compliance: Comply with NEC as applicable to construction and installation.

NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation."

UL Compliance: Provide electrical components and devices which are UL listed and labeled.

Electrical Service:

The contractor shall coordinate with the electric utility the installation of electrical service. Electric utility personnel shall install the lines and equipment as necessary.

The Contractor shall coordinate with the electric utility to provide the services described. Any and all costs and fees imposed by the utility company for service shall be the responsibility of the Contractor.

SECTION 16225 – ELECTRICAL SERVICE ENCLOSURE

NEC Compliance: Comply with NEC as applicable to construction and installation.

NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation".

UL Compliance: Provide electrical components and devices that are UL listed and labeled.

Electrical Service Enclosure:

All electrical power and instrumentation equipment shall be housed in a NEMA 4 stainless steel enclosure suitable for outdoor installations. The enclosure shall be suitable for mounting on a concrete pad.

Enclosures shall be manufactured from 12 gauge, Type 316 stainless steel. All hardware including the hinges, latches and padlock provisions shall be stainless steel. The physical size of the enclosure shall be determined by the equipment manufacturer(s), contractors and the engineer and shall be sufficient to allow for panel covers to be removed without interference with other components.

Removable sub-panels shall be 12 gauge formed steel. The panel shall be degreased, cleaned and treated with a phosphatizing process, then primed and painted with white industrial grade baking enamel.

Enclosures shall be furnished with heater and thermostat when specified on the design drawings. Contractor shall wire heater to an available circuits and adjust thermostat to maintain 40 degrees F.

The size of the equipment enclosure shall be determined by the contractors and the engineer, but not smaller than indicated on the electrical drawings. Enclosure shall have 16" floor stands.

Installation:

Install electrical equipment enclosure as indicated, in accordance with manufacturer's written instructions and with recognized industry practices. Comply with installation requirements of NECA and NEC.

Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation with other work.

SECTION 16452 - GROUNDING

Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.

UL Compliance: Comply with applicable requirements of UL 467, 486A and 869 pertaining to grounding and bonding of systems, circuits and equipment. Provide grounding and bonding products which are UL listed and labeled for their intended usage.

IEEE Compliance: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.

Manufacturers: One of the following (for each type of grounding and bonding product):

Adalet-PLM Div; Scott Fetzer Co.
 Burndy Corporation
 Cadweld Div; Erico Products Inc.
 Crouse-Hinds Div; Cooper Industries
 Eagle Electric Mfg Co.
 Ideal Industries, Inc.
 Joslyn Corporation
 Okonite Company
 OZ Gedney Div; General Signal Corp.
 Thomas and Betts Corp.

Materials and Components:

General: Except as otherwise indicated, provide electrical grounding and bonding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, solder less lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products that comply with NEC, UL and IEEE requirements and with established industry standards for those applications indicated.

Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match power supply wiring materials and are sized according to NEC.

Conductors: Copper cable, strand dia 0.045"; 0.187#/ft; 57,400 circular mils

Conductors: Copper solid strip; 0.051" thick; 1" wide

Conductors: Copper solid rod; 0.187#/ft.

Conductors: Copper cable, strand dia 0.045"; 14 strands

Conductors: Copper solid strip; 0.051" thick; 2" wide

Conductors: Copper solid rod; dia 0.162"

Bonding Jumper Braid: Copper braided tape, constructed of 30-gauge bare copper wires and properly sized for indicated applications.

Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gauge bare copper wire; 3/4" wide, 9 1/2" long; 48,250 CM. Select braid with holes sized for 3/8" diameter bolts and protect braid with copper bolthole ends.

Bonding Plates, Connectors, Terminals and Clamps: Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by bonding plate, connector, terminal and clamp manufacturers for indicated applications.

Ground Electrodes and Plates:

Grounding Electrodes: Steel with copper welded exterior, 3/4" dia by 10 feet.

Plate Electrodes: Sheet copper plate, 20-page by 36" x 36" with 2 cable attachments sized as indicated for either 1/0 or 1/0 cables.

Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type of service indicated.

Field Welding: Comply with AWS Code for procedures, appearance and quality of welds; and methods used in correcting welding work. Provide welded connections where grounding conductors connect to undergrounding and plates electrodes.

Installation:

Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.

Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system with other work.

Weld grounding conductors to underground grounding electrodes.

Ground electrical service system neutral at service entrance equipment to grounding electrodes.

Ground each separately-derived system neutral to:

Separate grounding electrode and water pipe or building steel.

Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors and plumbing systems.

Terminate feeder and branch circuit insulated equipment grounding conductors with a grounding lug, bus or bushing.

Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises.

Apply corrosion-resistant finish to field connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

Install clamp-on connectors to clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

Ground resistance shall be 10 OHMS or less.

SECTION 16460 - TRANSFORMERS

NEC Compliance: Comply with applicable requirements of NEC for electrical power/distribution transformers.

Standard Compliance: ANSI, IEEE, NEMA, NESC, and REA.

ANSI/UL Compliance: ANSI C57-Series and UL 506. Provide products that are UL listed and labeled.

Manufacturers: Provide transformers of one of the following (for each type of transformer):

Basler Electric Co.
Cutler Hammer Div; Eaton Corp.
Ferranti-Packard Inc.
General Electric Co.
Hevi-Duty Electric Div; General Signal Corp.
Siemens-Allis Inc.
Sorgel Electric Div; Square D Co.
Westinghouse Electric Corp.

General: Provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer and as required for complete installation.

Dry-Type Distribution Transformers (45 kVA or less): Provide factory-assembled, general purpose, air cooled, dry type distribution transformers where shown; of sizes, characteristics and rated capacities indicated; single-phase; 60 hertz, 30 kV BIL, 4.0% impedance with primary and secondary voltage as indicated, or three-phase; 60 hertz, 30 kV BIL, 4.0% impedance with primary and secondary voltage as indicated. Provide primary winding with 2 taps; both 5% increments below full-rated voltage for de-energized tap-changing operation. Insulate with Class 150 insulation and rate for continuous operation at kVA. Limit transformer surface temperature rise to maximum of 65 deg. C. Provide terminal enclosure, with cover, to accommodate primary and secondary coil wiring connections and electrical supply raceway terminal connector. Equip terminal leads with connectors installed. Limit terminal compartment temperature to 75 deg. C when transformer is operating continuously at rated load with ambient temperature of 40 deg. C. Provide wiring connectors suitable for copper or aluminum wiring. Cushion-mount transformers with external vibration isolation supports; sound level ratings not to exceed 45 db as determined in accordance with ANSI/NEMA standards. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap. Provide transformers with fully enclosed sheet steel enclosures. Apply manufacturer's standard light gray indoor enamel over cleaned and phosphatized steel enclosure. Provide transformers suitable for wall mounting.

Installation:

Install transformers as indicated, in accordance with equipment manufacturer's written instruction and with NEC, NESC, ANSI, NEMA and IEEE standards.

Coordinate transformer work with electrical raceway and wire/cable work, as necessary for proper interface.

Install units on vibration mounts as shown, complying with manufacturer's indicated installation method if any.

Connect transformer units to electrical wiring system; comply with requirements of other Division 16 sections.

Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing

requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A and B.

Provide equipment grounding and bonding connections for transformers as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounding.

Test installed transformers to demonstrate capability and compliance with requirements. Field correct malfunctioning units, or replace units where not field correctable, and proceed with retesting.

SECTION 16470 - PANELBOARDS

Codes and Standards:

Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 384 as applicable to installation, and construction of panelboards.

UL Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards", and UL's 50, 869, 486A, 486B and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL listed and labeled.

Special Use Markings: Provide panelboards, constructed for special use, with appropriate UL markings which indicates that special type of use/application.

NEMA Compliance: Comply with NEMA Stds Pub/No. 250, Pub/No. PB1, and Pub/No. PB 1.1 pertaining to panelboards.

Federal Specification Compliance: Comply with FS W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

Manufacturers: Provide panelboard products of one of the following (for each type and rating of panelboard and enclosure):

Crouse-Hinds Company
Cutler-Hammer Products, Eaton Corp.
Federal Pacific Electric Co.
General Electric Company
Gould, Inc.
Nelson Electric; Div of General Signal Corp.
Parker Electrical Mfg Co.
Siemens-Allis, Inc.
Square D Company
Westinghouse Electric Corp.

Panelboards:

General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components of types, sizes and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

Power Distribution Panelboards: Provide dead-front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors. Select unit with feeders connecting at top of panel. Equip with copper bus bars with not less than 98% conductivity, and with full sized neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections. Provide molded-case main and branch circuit breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.

Lighting and Appliance Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, when switching and protective devices in quantities, ratings, types and arrangements as shown; with anti-burn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting feeders at top of panel; equip with copper bus bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole lugs on neutral bus for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.

Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gauge, minimum 16-gauge thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

Molded-Case Circuit Breakers: Provide factory assembled, molded-case circuit breakers of frame sizes, characteristics and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault current limiting protection, ampere ratings as indicated. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 40 deg. C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, cartridge and plug time-delay type fuses, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.

Installation:

Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std's 486A and B.

Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

Provide properly wired electrical connections for panelboards within enclosures.

Fill out panelboard's circuit directory card upon completion of installation work.

Insert fuses, if any, of ratings indicated, within installed panelboards.

Grounding: Provide equipment-grounding connections for panelboard enclosures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.

Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

Prior to energization, check panelboards for electrical continuity of circuits and for short-circuits.

Adjust operating mechanisms for free mechanical movement.

Touch-up scratched or marred surfaces to match original finishes.

Demonstration: Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

AS-BUILTS

At the conclusion of the installation of all electrical components, electrical as-builts shall be provided by the contractor to the owner and engineer. As-builts shall include the physical locations, horizontal and vertical, of installed electrical components including, but not limited to, conduit, trace wire, lights, security cameras, receptacle, cabinets, and all other associated components.

SECTION 16999 - MEASUREMENT AND PAYMENT

Pay Item

Pay Unit

PAVILION MOUNTED LUMINAIRE, INCLUDING ALL RIGID
CONDUIT, WIRE, HAND HOLES, AND CONNECTIONS FOR
A FULLY FUNCTIONING SYSTEM

UNIT

Payment for furnishing and installing lighting fixtures as specified will be made at the unit price bid for said item as listed in the Bid Form. Said bid prices shall include all materials, labor, and foundations required for permanent anchoring and installation.

APPENDIX

ARCHITECTURAL PLANS AND SPECIFICATIONS

SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. Extent of concrete work is shown on drawings.

1.3 SUBMITTALS

- A. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds and others as required by Architect.
- B. Samples: Submit samples of materials as requested by Architect, including names, sources and descriptions.
- C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test.
- D. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
- E. Shop Drawings: Reinforcement: Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing diagrams of bent bars, arrangement of concrete reinforcement.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 301 "Specifications for Structural Concrete for Buildings".
 - 2. ACI 318 "Building Code Requirements for Reinforced Concrete".
 - 3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".
- B. Concrete Testing Service: Engage a testing laboratory acceptable to Architect to perform material evaluation tests and to design concrete mixes.

- C. Materials and installed work may require testing and retesting at anytime during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.
- D. Welded Deformed Steel Wire Fabric: ASTM A 497.
- E. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II.
 - 1. Use one brand of cement throughout project, unless otherwise acceptable to Architect.
- B. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
- C. Light Weight Aggregates: ASTM C330 and as herein specified, coarse shale, slate or slag aggregate, free from expanded clay
- D. Water: Drinkable.

- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Air-Mix"; Euclid Chemical Co.
 - b. "Sika Aer"; Sika Corp.
 - c. "MB-VR or MB-AE"; Master Builders.
 - d. "Darex AEA" or "Daravair"; W.R. Grace.
- F. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.05 percent chloride ions.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "WRDA" Hycol"; W.R.Grace.
 - b. "Eucon WR-75" or "Eucon WR-89"; Euclid Chemical Co.
 - c. "Pozzolith 322N"; Master Builders.
- G. High-Range Water-Reducing Admixture (Super Plasticizer) ASTM C 494, Type F or Type G and containing not more than 0.05 percent chloride ions.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Daracem 100" or "WRDA-19"; W.R. Grace.
 - b. "Eucon 37"; Euclid Chemical Co.
 - c. "Rheobuild 1000"; Master Builders.
 - d. "Sika 86"; Sika Corporation.
- H. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.024 percent chloride ions.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Accelguard 80"; Euclid Chemical Co.
 - b. "Daraset"; W.R. Grace
 - c. "Plastocrete 161FL" or "SikaSet NC"; Sika Corporation
- I. Water-Reducing, Retarding Admixture: ASTM C 494, Type D and containing not more than 0.05 percent chloride ions.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Pozzolith Retarder"; Master Builders.

PICNIC SHELTER & RESTROOMS AT
CHALLENGE GROVE PARK
CAMDEN COUNTY PARK
COMMISSION NO. 19M014

- b. "Eucon Retarder 75"; Euclid Chemical Co.
- c. "Daratard 17"; W.R. Grace.
- d. "Plastocrete 161R"; Sika Corporation.

J. Prohibited Admixtures: Calcium chloride thycyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.

2.4 RELATED MATERIALS

A. Extruded Polystyrene Board Insulation: Rigid closed-cell extruded, expanded polystyrene insulation board with integral high-density skin, complying with ASTM C-578 Type IV: min. 25 psi compressive strength ASTM D 1621: k value of 0.20 ASTM C 518: 0.30% maximum water absorption ASTM C272: 1.1 perm/inch max water vapor transmission: manufacturer's standard length and widths.

1. Manufacturer: Subject to compliance with requirements, provide products of one of the following or an approved equal:

- a. Dow Chemical Co: Midland MI
- b. VC Industries/V.5 Gypsum: Chicago, IL.
- c. GreenGuard XPS: Pactive LLC: Austin, TX

B. Non-Shrink Grout: CRD-C 621, factory pre-mixed grout.

- 1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
- 2. Products: Subject to compliance with requirements provide one of the following:
- 3. Non-metallic

- a. "Euco-NS"; Euclid Chemical Co.
- b. "Duragrout"; L&M Construction Chemicals, Inc.
- c. "Masterflow 713"; Master Builders
- d. "Five Star Grout"; U.S. Grout Corporation.

C. Absorptive Cover: Burlap cloth made from jute or kenaf weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

D. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

- 1. Waterproof paper.
- 2. Polyethylene film.
- 3. Polyethylene-coated burlap.

E. Clear curing and sealing compound (VOC Compliant): The compound shall have 30% solids content minimum, and will not yellow under ultraviolet light after 500 hours of test in accordance with ASTM C-1315 and will have test data from an independent testing laboratory indicating a maximum moisture loss of 0.039 grams per sq. cm. when applied at a rate of 300 sq. ft. per gallon. Sodium silicate compounds are not permitted.

1. Product: "Super Aqua-Cure VOX" by Euclid Chemical Co.
 2. Product: "Dress & Seal WB30" by L&M Construction Chemicals, Inc
 3. Product: "Kure-n-Seal 30 VOC" by Sonneborne
 4. Or approved equal.
- F. Vapor Barrier: Provide vapor barrier which conforms to ASTM E1745, Class A. The membrane shall have a water-vapor transmission rate no greater than 0.01 gr./ft²/hr/inch Hg when tested in accordance with ASTM E96. The vapor barrier shall be placed over prepared base material where indicated below slabs on grade. Vapor barrier shall be no less than 15 mil thick. Installation of vapor barrier to comply with ASTM E1643.
1. Product: Stego Wrap (15 mil) Vapor Barrier by Stego Industries LLC
 2. Product: VaporBlock (15 mil) by Raven Industries
 3. Product: Zero Perm by Alumiseal
 4. Product: Premoulded Membrane with PLASMATIC CORE by W.R. Meadows.

2.5 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
- B. Submit written reports to Architect and Structural Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.
- C. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:
- D. For normal weight aggregate mixes: 3000 psi 28-day compressive strength; W/C ratio, 0.51 maximum, 3500 psi 28-day compressive strength W/C ratio, 0.47 maximum.
- E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be admitted to and accepted by Architect before using in work.
- F. Admixtures:
1. Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.
 2. Use high-range water-reducing admixture in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight and concrete with water/cement ratios below 0.50.
 3. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

4. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits.

- a. 5% for maximum 2" aggregate
- b. 6% for maximum 3/4" aggregate
- c. 7% for maximum 1/2" aggregate

- G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, slabs and sloping surfaces: Not more than 3".
2. Reinforced foundation systems: Not less than 1" and not more than 3".
3. Concrete containing HRWR admixture (super-plasticizer): Not more than 8" after addition of HRWR to site-verified 2"-3" slump concrete.
4. Other concrete: Not less than 1" nor more than 4"

2.6 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.
- B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

PART 3 - EXECUTION

3.1 FORMS

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structure are of correct size, shape, alignment, elevations and position.
- B. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features, required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

3.2 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
 1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

- B. Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.3 JOINTS

- A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate at a maximum spacing of 90 feet, so as not to impair strength and appearance of the structure, as acceptable to Architect.
- B. Control Joints: Locate and install control joints as indicated or at a maximum spacing of 30 feet. Locate at a spacing which does not impair appearance of the structure as acceptable to Architect. Use "SOFFCUT" saw to cut joints in slab. Joint to be cut the same day as the pour.
- C. Joint filler and sealant materials are specified in Division-7 sections of these specifications.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.
- B. Edge Forms and Screed Strips for Slabs: Set edge forms, or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.5 CONCRETE PLACEMENT

- A. Preplacement inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.

Moisten wood forms immediately before placing concrete where form coatings are not used.

1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.
- B. General: Comply with ACI 304R "Guide for Measuring, Mixing, Transporting and Placing Concrete", and as herein specified.
- C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- D. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
- E. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- F. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
- G. Maintain reinforcing in proper position during concrete placement operations.
- H. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which would be caused by frost, freezing actions or low temperatures, in compliance with ACI 306R.
- I. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- J. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305R.

3.6 MONOLITHIC SLAB FINISHES

- A. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.
- B. After screeding, consolidating and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate

surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of Ff18 - Ff15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

- C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
- D. After floating, begin first trowel finish operation using a power driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff20 - Ff17. Grind smooth surface defects which would telegraph through supplied floor covering system.
- E. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps and elsewhere as indicated.

3.7 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- D. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing and by combinations thereof, as herein specified.
- E. Provide moisture curing by following methods.
 - 1. Keep concrete surface continuously wet by covering with water.
 - 2. Continuous water-fog spray.
 - 3. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
- F. Provide moisture-cover curing as follows:
 - 1. Cover concrete surfaces with moisture-retaining cover for curing concrete, place in widest practicable width with sides and ends lapped at least 3" and sealed by

waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

- G. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting and other coatings and finish materials, unless otherwise acceptable to Architect.
- H. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.
- I. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture retaining cover, unless otherwise directed.

3.8 MISCELLANEOUS CONCRETE ITEMS

- A. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

3.9 CONCRETE SURFACE REPAIRS

- A. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
- B. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets and other objectionable conditions.
- C. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
- D. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.
- E. Underlayment Application: Leveling of floors for subsequent finishes may be achieved by use of specified underlayment material.

3.10 QUALITY CONTROL TESTING DURING CONSTRUCTION

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- A. The Owner will employ a testing laboratory to perform the following tests, inspect formwork and reinforcement placement and to submit test reports.
- B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Architect.
- C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - 1. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 - 2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
- D. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
- E. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
- F. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
- G. Test results will be reported in writing to Architect, Structural Engineer and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
- H. Nondestructive Testing: Impact hammer, sonoscope or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- I. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION 033000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Cast stone trim.
 - 3. Manufactured stone veneer.
 - 4. Mortar and grout.
 - 5. Steel reinforcing bars.
 - 6. Masonry-joint reinforcement.
 - 7. Ties and anchors.
 - 8. Miscellaneous masonry accessories.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

- A. Product Data: For each type of masonry product and accessory required.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing. Comply with ACI 315.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Verification: For each type and color of the following:
 - 1. Accessories embedded in masonry, including reinforcing, ties, anchors and flashings.

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 masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- D. Limit moisture absorption during delivery and until time of installation of the maximum percentage allowed by ASTM C 90 for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest the Project site.

1.6 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.
- B. 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.
- C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- D. Do not lay masonry units which are wet or frozen.
 - 1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
 - 2. Remove all masonry determined to be damaged by freezing conditions.
 - 3. Protection of masonry against freezing when the temperature of the surrounding air is 40° F. and falling. Heat materials and provide temporary protection of completed portions of masonry work.
- E. Furnish and install all temporary bracing required to prevent damage or stress to new masonry work by reason of which may be superimposed on the work. Provide all bracing rigid, secure and solidly anchored against movement. Remove when no longer required. The Contractor shall be solely responsible for any damage incurred to the masonry work, including contingent and/or related damage, due to failure to properly brace and protect against external forces.
- F. Coordination: Review installation procedures and coordinate with other work that must be integrated with unit masonry.

1.7 COORDINATION

- A. Contractor will cooperate with other trades in building their work and equipment as masonry work progresses as follows:
 - 1. Contractor shall thoroughly familiarize himself with Plumbing, Mechanical and Electrical Drawings and build at proper locations and elevations all openings for registers, grilles, louvers slots, chases, pipes, vents, heating units, drinking fountains, ducts, etc. as required. Cut neatly around all ducts, pipes, etc., where required. Mortar solid, seal or firestop joints between cut openings and face of pipe sleeves, conduit runs and ductwork so that no opening exists through the masonry.
 - 2. Build in conduit, plugs, sleeves, etc. as required for fastening of panels, electric, switches, receptacles, controls, etc. required by Mechanical and Electrical trades.

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 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 or will impair the quality of finished masonry work.

2.3 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, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. At interior locations provide bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.

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1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
2. Density Classification: as noted below by type.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's selections.
 - a. Foundation Units (below grade): Normal weight, load bearing units, (125 lbs/cu ft, or greater, oven dry weight of concrete) with at least 75% cross sectional area at bedding surfaces (bed faces).
 - b. Above grade units (exposed to exterior): Normal weight, load bearing, Architectural Faced Units, (125 lbs/cu ft, or greater, oven dry weight of concrete), with integral water repellent.

2.4 CAST-STONE UNITS

- A. Continental Cast Stone. (Basis-of-Design)
- B. Cast-Stone Units: Comply with ASTM C 1364.
 1. Units shall be manufactured using the vibrant dry tamp or wet-cast method.
 2. Units shall be resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666, Procedure A, as modified by ASTM C 1364.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 2. Provide drips on projecting elements unless otherwise indicated.
- D. Fabrication Tolerances:
 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
- E. Cure Units as Follows:
 1. Cure units in enclosed, moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
- F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- G. Colors and Textures: Provide units with fine-grained texture and buff color resembling sand-rubbed Indiana limestone.

2.5 MANUFACTURED STONE VENEER

- A. Material Standard: Comply with ASTM C1670.
- B. Description: Manufactured cultured stone veneer – Dressed Fieldstone or Limestone includes matching corner pieces.
- C. Varieties and Sources: Subject to compliance with requirements, available stone varieties that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Borl Stone
 - 2. Coronado Stone Products
 - 3. Eldorado Stone
- D. Texture & Color: As selected by Architect from full range of manufacturer's standard.

2.6 MORTAR AND GROUT 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.
 - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S. Do not use air entraining additives.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. 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.
- E. Aggregate for Grout: ASTM C 404.
- F. Cold-Weather Admixture: Non-chloride, non-corrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Euclid Chemical Company (The); Accelguard 80.
 - 2. Grace Construction Products; W. R. Grace & Co.; Morset.
 - 3. Sonneborn Products, BASF; Trimix-NCA.
- G. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - 1. Hohmann & Barnard, Inc.; RB and/or RB-Twin Rebar Positioners, or approved equal. Provide with Spyra-Lox Rebar Lap-Joint Tie where reinforcing bars are lapped.
- C. Masonry-Joint Reinforcement, General: ASTM A 951.
 - 1. Interior Walls: Hot-dip galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.187-inch diameter.
 - 4. Wire Size for Cross Rods: 0.187-inch diameter.
 - 5. Wire Size for Veneer Ties: 0.187-inch diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 - 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer 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, with ASTM A 153, Class B-2 coating.
 - 2. Stainless-Steel Wire: ASTM A 580, Type 304 [Type 316].
 - 3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, with ASTM A 153, Class B coating.
 - 4. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304 [Type 316].
 - 5. Steel Plates, Shapes, and Bars: ASTM A 36.
 - 6. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.
- C. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch thick steel sheet, galvanized after fabrication.
- D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.
 2. Where wythes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
 3. Wire: Fabricate from 3/16-inch diameter, hot-dip galvanized steel wire.
- E. Rigid Anchors: Fabricate from hot-dipped galvanized 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.
- F. Anchor bolts: Galvanized steel, 1/2" diameter x 16" long with 3" leg or as indicated on drawings.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips in thicknesses required, complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: No. 15 Asphalt-saturated felt complying with ASTM D 226, Type I.
- D. Expanded Metal Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m), self-furring, diamond-mesh lath complying with ASTM C847. Fabricate from structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G60 (Z180).

2.10 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. Use portland cement-lime 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. 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 or needed to provide required compressive strength of masonry].
1. For masonry below grade or in contact with earth, use Type M.
 2. For reinforced masonry, use Type S.
 3. For mortar parge coats, use Type N.

4. For exterior, above-grade, load-bearing and non-loadbearing walls and parapet walls; for interior load-bearing walls; for interior non-loadbearing partitions; and for other applications where another type is not indicated, use Type N.
 5. Use Type M mortar to set anchor bolts and grout base plates.
- C. 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, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

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. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build walls to actual widths of masonry units, using units of widths indicated.
- B. 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.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- D. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperature existing at time of installation

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except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintaining mixing temperature selected within 10° F.

1. 40°F to 32°F:
 - a. Mortar: Heat mixing water to produce mortar temperature between 40°F and 120°F.
 - b. Grout: Follow normal masonry procedures.
2. 32°F to 25°F:
 - a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F and 120°F; maintain temperature of mortar on boards above freezing.
 - b. Grout: Heat grout materials to 90°F to produce in place grout temperature of 70°F at end of work day.
3. 25°F to 20°F:
 - a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F and 120°F; maintain temperature of mortar on boards above freezing.
 - b. Grout: Heat grout materials to 90°F to produce in-place grout temperature of 70°F at end of work day.
 - c. Heat both sides of wall under construction using salamanders or other heat sources.
 - d. Use windbreaks or enclosures when wind is excess of 15 mph.
4. 20°F and below:
 - a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F and 120°F.
 - b. Grout: Heat grout materials to 90°F to produce in-place grout temperature of 70°F at end of work day.
 - c. Masonry Units: Heat masonry units so that they are above 20°F at time of laying.
 - d. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40°F for 24 hours after laying units.
 - e. Do not heat water for mortar and grout to above 160°F.
 - f. Protect completed masonry and masonry not being worked on in the following manner:
 - g. Temperature ranges indicated apply to mean daily air temperature except for grouted masonry. For grouted masonry temperature ranges apply to anticipated minimum night temperatures.
5. 40°F to 32°F:
 - a. Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
6. 32°F to 20°F:

- a. Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
7. 20°F and below:
- a. Except as otherwise indicated, maintain masonry temperature above 32°F for 24 hours using enclosures using and supplementary heat, electric heating blankets, infrared lamps or other methods proved to be satisfactory. For grouted masonry maintain heated enclosure to 40°F for 48 hours.

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 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.
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.

3.4 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. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping 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.
- G. 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.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above 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 and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.

3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. Interior Walls intersecting exterior walls shall not be tied in masonry bond. Terminate interior wall at face of exterior wall with a control joint and rake out 3/8" for caulking. Except at firewalls, tie walls together for lateral support with Rigid Anchors. Bends at the ends of anchors shall be embedded in cores filled with mortar. Place pieces of mortar/grout screen under anchor and over core to support mortar. Anchors are to be spaced every 48 inches o.c. vertically.
5. Wall Bracing: Adequately brace all walls against forces and pressures during entire construction period.

3.5 MORTAR BEDDING AND JOINTING

A. Lay 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.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. 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.

C. 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.
2. Match coursing, bonding, color, and texture of existing masonry.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Rake out mortar for joints to receive caulking around door and window frames, and elsewhere as shown.

F. Maintain joint widths, except for minor variations required to maintain bond alignment, or where applicable to match existing. If not otherwise indicated, lay walls with 3/8" joints. Cut joints flush for masonry walls that are to be concealed or to be covered by other materials. Fill scored joints of masonry units and precast lintels with mortar to be tooled to match other mortar joints. Tool exposed joints slightly concave, including joints in cavity walls and scored joints of masonry units.

G. Batch Control:

1. Measure and batch materials either by volume or weight, such that the required proportions for mortar can be accurately controlled and maintained.
2. Mix mortars with the maximum amount of water consistent with workability to provide maximum tensile bond strength within the capacity of the mortar.
3. Mix mortar ingredients for a minimum of five minutes in a mechanical batch mixer. Use water clean and free of deleterious materials which would impair the work. Do not use mortar which has begun to set, or if more than 2-1/2 hours has elapsed since initial mixing. Re-temper mortar during 2-1/2 hour period as required to restore workability.

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 and parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- 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.

END OF SECTION 042000

PART 1 - SECTION 055010 - MISCELLANEOUS METALS

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. Provide all plant, labor, materials, accessories, equipment and incidentals to complete Miscellaneous Metals work, as shown, specified, and as required, including, but not necessarily limited to, the following:
 - 1. Rough hardware.
 - 2. Loose bearing and leveling plates, steel lintels, shelf angles, plates, bars, angles, etc.
 - 3. Miscellaneous framing and supports to support other work including mechanical and electrical equipment and other applications where framing and supports are not specified in other sections.
 - 4. Miscellaneous fabrications as noted and/or required to properly complete the project.

1.3 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following, except as other-wise indicated:
 - 1. IBC International Building Code 2015, New Jersey Edition
 - 2. AISC "Manual of Steel Construction".
 - 3. AWS Structural Welding Codes
- B. Qualifications for welding work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".
- C. Welding: Use qualified welders and comply with American Welding Society (AWS) D1.1, "Structural Welding Code – Steel", (AWS) D1.3, "Structural Welding Code – Sheet Steel".
- D. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.
- E. Preassemble miscellaneous metal items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

- F. Be responsible for interface coordination between work provided and related work of other trades and contracts.
- G. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications, anchor details, installation and application instructions for metal products, fabrications, accessories and primer paint used in miscellaneous metal fabrications, including paint products and grout.
- B. Shop Drawings: Submit shop drawings showing complete details and schedules for fabrication and erection. Include plans, elevations, details of sections, connections, anchorage, accessory items and material properties. Provide templates and setting drawings. Indicate all adjacent work to which the fabrications are attached or with which components must interface.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site at such intervals to insure uninterrupted progress of the work.
- B. Store materials to permit easy access for inspection and identification. Keep metals inside a well-ventilated area off the ground, using pallets, platforms, or other supports. Protect metal members and packaged materials from corrosion and deterioration.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Where miscellaneous metal work is indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating miscellaneous metal work without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, stains, discoloration, rolled trade names, roughness and other imperfections.

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- B. Steel Plates, Shapes and Bars: ASTM A36/A36M.
- C. Steel Bar Grating: ASTM A569 or ASTM A36.
- D. Steel Tubing: Cold formed, ASTM A500; or hot rolled, ASTM A501.
- E. Structural Steel Sheet: Hot rolled, ASTM A570; or cold rolled, ASTM A611, Class 1, of grade required for design loading, unless otherwise indicated.
- F. Galvanized Structural Steel Sheet: ASTM A446, of grade required for design loading. Coating designation as indicated, or it not indicated, G90.
- G. Steel Pipe: ASTM A53, Type and grade (if applicable) as selected by Fabricator and as required for design loading stainless steel, black iron or galvanized as indicated; standard weight (Schedule 40), unless otherwise indicated, or another weight as required by structural loads.
- H. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
- I. Grout:
 - 1. Metallic Non-Shrink Grout: Pre-mixed, factory-packaged, ferrous aggregate grout in accordance with CE CRD-C588, Type M and ASTM C 1107. Provide grout specifically recommended by manufacturer for heavy-duty loading applications.
 - 2. Non-Shrink, Non-Metallic Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, non gaseous grout complying with CE CRD C621 and ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications of types specified herein.
- J. Fasteners:
 - 1. General: Provide zinc-coated fasteners for exterior or where built into exterior walls. Select fasteners for the type, grade and class required.
 - 2. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563/A 563M; and where indicated, flat washers.
 - 3. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
 - 4. Wood Screws: Flat head carbon steel, ASME B18.6.1.
 - 5. Anchor Bolts: ASTM F1554, Grade 36.
 - 6. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
 - 7. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).
 - 8. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.22.2M).
 - 9. Toggle Bolts: Tumble-wing type, class and style as needed, FS FF-B-588.
 - 10. Masonry Anchorage Devices: Expansion shields FS FF-S-325.

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- K. Welding Rods and Bare Electrodes and Filler Material: Provide type and alloy of filler metal and electrodes according to AWS specifications for metal alloy welded and as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- L. Materials for Miscellaneous Steel: For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
- M. Paint:
 - 1. Primer selected to be compatible with finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Section 099000.
 - 2. Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.
 - 3. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.
 - 4. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION

- A. Workmanship: Use of materials of size and thickness indicated or, if not indicated, as required to produce strength and durability in finished product for use intended. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for various components or work.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- C. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Use fasteners of same basic metal as fastened metal unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
- E. Provide for anchorage of type indicated and as required, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- F. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive hardware and similar items.

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- G. Fabricate joints that will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.
- H. Electrodes for Welding: Comply with AWS Code and as recommended by product manufacturer.
- I. Rough Hardware: Furnish bent or otherwise custom fabricated bolts, plates, inserts, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing, supporting, anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 - Sections.
- J. Fabricate items to sizes, and shapes and dimensions required. Furnish malleable-iron washers for heads and nuts that bear on wood structural connections; elsewhere, furnish steel washers.
- K. Shelf Angles: Furnish and install structural steel shelf angles of sizes indicated and required for attachments to concrete framing. Provide slotted holes to receive 3/4" bolts, spaces not more than 6" from ends and not more than 24" o.c. unless otherwise indicated.
- L. Loose Bearing and Leveling Plates: Furnish and install loose bearing and leveling plates for steel items bearing on masonry or concrete constructions, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting required. Galvanize after fabrication.
- M. Loose Steel Lintels: Furnish and install loose structural steel lintels for openings and recesses in masonry walls and partitions whether they are indicated in the lintel schedule or not. Weld adjoining members together to form a single unit where indicated. Provide not less than 8" bearing at each side of openings, unless otherwise indicated.
- N. Miscellaneous Steel Framing and Supports: Furnish and install miscellaneous steel framing and supports which are not part of structural steel framework, as required to complete work.
- O. Fabricate miscellaneous units to sizes, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise indicated, fabricate from structural steel shapes and plates and steel bars of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- P. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
- Q. Except as otherwise shown, space anchors 24" o.c. and provide minimum anchor units of 1-1/4" x 1/4" x 8" steel straps.
- R. Galvanize all exterior miscellaneous frames, supports and trim. All interior miscellaneous frames, supports and trim at wet and high humidity areas and as otherwise indicated.

S. Galvanizing:

1. Provide a zinc coating for those items indicated or specified to be galvanized, as follows:
Unit noted to be galvanized are to be hot dipped galvanized after fabrication.
 - a. ASTM A 153 for galvanizing iron and steel hardware.
 - b. ASTM A 123 for galvanizing rolled, pressed, and forged steel shapes, plates, bars, and strip 1/8" thick and heavier.
 - c. ASTM A 386 for galvanizing assembled steel products.
- T. Miscellaneous Steel Trim: Provide shapes and sizes for profiles indicated. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.

2.3 COATINGS AND PRIMER PAINTS

- A. Shop paint miscellaneous metal work, except members or portions of members to be embedded in concrete, masonry and surfaces and edges to be field welded, galvanized or finished metal surfaces unless otherwise indicated.
- B. Remove scale, rust and other deleterious materials before applying shop coat. Clean off heavy rust and loose mill scale in accordance with SSPC SP-2 (Hand Tool Cleaning), SSPC SP-3 (Power Tool Cleaning) or SSPC SP-6 (Commercial Blast Cleaning). Omit blast cleaning for interior work.
- C. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 (Solvent Cleaning).
- D. Interior Ferrous Items: Manufacturer's standard, fast curing, lead free, universal primer, selected for resistance to normal atmospheric corrosion, for compatibility with proposed finish paint systems and for capability to provide a sound foundation for field applied topcoats despite prolonged exposure; complying with performance requirements of FS TT-P-645. Use painting methods that will result in full coverage of joints, corners, edges and all exposed surfaces.
- E. Apply one shop coat to fabricated metal items, except apply 2 coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.
- F. Exterior Steel Items: Hot dipped galvanized to receive finish coats; ASTM A 153, A123, and A386, unless otherwise noted.
- G. Galvanized coating repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780. SSPC P-20 or Mil-P-21D3T.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine the areas and conditions under which work is to be installed and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the erector.

3.2 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.3 INSTALLATION

- A. Install miscellaneous metals in accordance with referenced standards and as shown on final approved shop drawings.
- B. Install manufactured products in conformance with manufacturer's recommendations.
- C. Fastening to In-Place Construction:
 - 1. Except as otherwise specified, provide anchorage devices and fasteners where necessary for securing metal fabrication items to in place construction including threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, lag bolts, and other connectors as required.
- D. Cutting, Fitting and Placement:
 - 1. Perform cutting, drilling and fitting required for the installation of the miscellaneous metal items. Set the work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in form work for items which are to be built into concrete, masonry or similar construction.
 - 2. Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of units and components which are zinc coated, shop prime painted, or finish after fabrication or are intended for mechanical field connections or other means without further cutting or fitting.
- E. Field Welding:
 - 1. Comply with AWS Code for the procedures of manual shielded metal arc welding, the appearance and quality for welds made, and the methods used in correcting welding work. Use materials and methods that minimize distortion, develop strength, and

corrosion resistance to base metals without undercut or overlap. Finish surfaces shall be left smooth and match contours of adjoining surfaces.

F. Setting Loose Plates:

1. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
2. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with the edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
3. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING, CLEANING AND PROTECTION

- A. Immediately after erection of steel items, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. For galvanized surfaces: Clean field welds, bolted connections and abraded areas and apply 2 coats of galvanizing repair paint.
- C. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055010

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Wood poles and beams.
 - 3. Wood blocking, cants, and nailers.
 - 4. Wood furring and grounds.
 - 5. Plywood backing panels.

1.3 DEFINITIONS

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

1.4 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. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. 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.
- C. 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.
 6. Metal framing 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.
- 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. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2 for interior construction not in contact with the ground, Category UC3b for exterior construction not in contact with the ground, and Category UC4a for items in contact with the ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- C. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 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. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.
 - 2. Roof construction.
 - 3. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
 - 1. Application: Interior partitions not indicated as load-bearing.
 - 2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Mixed southern pine; SPIB.
 - c. Spruce-pine-fir; NLGA.
 - d. Hem-fir; WCLIB, or WWPA.
 - e. Northern species; NLGA.
 - f. Eastern softwoods; NeLMA.
- B. Load-Bearing Partitions: Construction or No. 2 grade.
 - 1. Application: Exterior walls and interior load-bearing partitions.
 - 2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Southern pine; SPIB.
 - c. Douglas fir-larch; WCLIB or WWPA.
 - d. Mixed southern pine; SPIB.
 - e. Spruce-pine-fir; NLGA.

- f. Douglas fir-south; WWPA.
- g. Hem-fir; WCLIB or WWPA.
- h. Douglas fir-larch (north); NLGA.

2.5 ENGINEERED WOOD PRODUCTS

- A. Engineered Wood Products, General: Products shall contain no urea formaldehyde.
- B. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
 - 1. Extreme Fiber Stress in Bending, Edgewise: 2900 psi for 12-inch nominal depth members.
 - 2. Modulus of Elasticity, Edgewise: 2,200,000 psi.

2.6 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
- B. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.7 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.
 - 1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- 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.

2.9 METAL FRAMING ANCHORS

- A. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated on drawings. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.

2.10 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch .
- B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
- C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

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 furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- F. 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.
- G. Comply with AWWPA 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.
- H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or 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-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal size furring vertically at 16 inches o.c.
- C. Furring to Receive Gypsum Board or Plaster Lath: Install 1-by-2-inch nominal size furring vertically at 16 inches o.c.

3.4 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.
 - 1. For exterior walls, provide 2-by-6-inch nominal size wood studs spaced 16 inches o.c. unless otherwise indicated.
 - 2. For interior partitions and walls, provide 2-by-6-inch nominal size wood studs spaced 16 inches o.c. unless otherwise indicated.
 - 3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
 - 2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated or, if not indicated, according to Table R502.5(1) or Table R502.5(2), as applicable, in ICC's International Residential Code for One- and Two-Family Dwellings.
- D. Provide diagonal bracing in exterior walls, at both walls of each external corner, at 45-degree angle, full-story height unless otherwise indicated. Use 1-by-4-inch nominal size boards, let-in flush with faces of studs] [metal wall bracing, let into studs in saw kerf.

3.5 PROTECTION

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

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Plywood sheathing, fasteners, and adhesives.

- B. Related Requirements:

- 1. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.3 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 plywood complies 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 plywood complies with requirements. Include physical properties of treated materials.
 - 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

- B. Evaluation Reports: For following products, from ICC-ES:

- 1. Preservative-treated plywood.
 - 2. Fire-retardant-treated plywood.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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."

2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with the ground, Category UC3b for exterior construction not in contact with the ground, and Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

- 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 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. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. 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. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings, and the following:
 - 1. Roof and wall sheathing within 48 inches of fire and party walls.
 - 2. Roof sheathing.
 - 3. Subflooring and underlayment for raised platforms.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

2.5 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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. Arrange joints so that pieces do not span between fewer than three support members.
- 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. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof 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.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. 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.

END OF SECTION 061600

SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

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. Wood roof trusses.

1.3 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For wood-preservative-treated lumber, metal-plate connectors, metal truss accessories, and fasteners.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 6. Show splice details and bearing details.

- C. Delegated-Design Submittal: For design of metal-plate-connected wood trusses 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. Qualification Data: For professional engineer and fabricator.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.
- D. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated lumber.
 - 2. Metal-plate connectors.
 - 3. Metal truss accessories.

1.6 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - 3. Provide for air circulation around stacks and under coverings.

- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, to design metal-plate-connected wood trusses and all supports.
- B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: 30 P.S.F.
 - 2. Maximum Deflection under Design Loads:
 - a. Roof Trusses: Vertical deflection of 1/180 of span.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (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, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S.
 - 4. Provide dry lumber with 15 percent maximum moisture content at time of dressing.
- B. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal (38 by 140 mm actual) for both top and bottom chords.
- C. Minimum Specific Gravity for Top Chords: 0.50.

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A 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.
 - 2. For exposed trusses 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 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.
- D. Application: Treat all trusses unless otherwise indicated.

2.4 METAL CONNECTOR PLATES

- A. Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

2.5 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
- B. Nails, Brads, and Staples: ASTM F1667.

2.6 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Allowable design loads, as published by manufacturer, shall comply with or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

PICNIC SHELTER & RESTROOMS AT
CHALLENGE GROVE PARK
CAMDEN COUNTY PARK
COMMISSION NO. 19M014

- B. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- C. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick. Tie fastens to one side of truss, top plates, and side of stud below.
- D. Roof Truss Clips: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, 1-1/4 inches (32 mm) wide by 0.050 inch (1.3 mm) thick. Clip is fastened to truss through slotted holes to allow for truss deflection.
- E. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches (38 mm) wide by 1 inch (25 mm) deep by 0.040 inch (1.0 mm) thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.
- F. Drag Strut Connectors: Angle clip with one leg extended for fastening to the side of girder truss.
 - 1. Angle clip is 3 by 3 by 0.179 by 8 inches (76 by 76 by 4.55 by 203 mm) with extended leg 8 inches (203 mm) long. Connector has galvanized finish.
 - 2. Angle clip is 3 by 3 by 0.239 by 10-1/2 inches (76 by 76 by 6.07 by 267 mm) with extended leg 10-1/2 inches (267 mm) long. Connector has painted finish.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.8 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses 24 inches (610 mm) o.c.; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
 - 1. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- L. Replace wood trusses that are damaged or do not comply with requirements.
 - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND 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.

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- B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces according to ASTM A780/A780M and manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

END OF SECTION 061753

SECTION 072100 - THERMAL 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 DESCRIPTION OF WORK

- A. Provide all labor, materials, accessories, equipment, and incidentals to complete building insulation, as shown and/or specified including, but not necessarily limited to, the following:
 - 1. Thermal batt insulation as required to provide thermal envelope.
 - 2. Perimeter and Under-Slab Foundation Insulation.
 - 3. Insulation support framing, fasteners and accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. 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: Submit manufacturer's specifications and installation instructions for each type of insulation required.
- B. QUALITY ASSURANCE
- C. Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.
 - 1. ASTM E 84 Surface Burning Characteristics.
 - 2. ASTM E 119 Fire Resistance Ratings.
 - 3. ASTM E 136 Combustion Characteristics.

- D. Provide insulations composed of mineral fibers or mineral ores which contain no asbestos, of any type or mixture of types occurring naturally as impurities, as determined by polarized light microscopy test per appendix of 40 CFR 73.

1.5 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.
- B. Protect plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.6 JOB CONDITIONS

- A. Do not proceed with the installation of insulation until subsequent work that conceals the insulation is ready to be performed. Complete and conceal insulation as rapidly as possible.

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 or approved equal.

2.2 GLASS-FIBER BLANKET INSULATION

- A. Available Manufacturers:
 - 1. CertainTeed Corporation.
 - 2. Guardian Fiberglass, Inc.
 - 3. Johns Manville.
 - 4. Knauf Fiber Glass.
 - 5. Owens Corning.

- B. Unfaced, Glass-Fiber Blanket Insulation (Above Ceilings): ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread rating 25, smoke-developed rating 450 or less, passing ASTM E 136 for combustion characteristics.
- C. Where glass-fiber blanket insulation is indicated by the following thicknesses, or if not indicated, to fill stud or joist depth, provide blankets in batt or roll form with thermal resistances indicated:
 - 1. 3-1/2 inches (89 mm) thick with a thermal resistance of 13 deg F x h x sq. ft./Btu at 75 deg F (2.3 K x sq. m/W at 24 deg C).
 - 2. 5-1/2 inches (140 mm) thick with a thermal resistance of 19 deg F x h x sq. ft./Btu at 75 deg F (3.3 K x sq. m/W at 24 deg C).
 - 3. 6-1/2 inches (165 mm) thick with a thermal resistance of 21 deg F x h x sq. ft./Btu at 75 deg F (3.7 K x sq. m/W at 24 deg C).
 - 4. 9-1/2 inches (241 mm) thick with a thermal resistance of 30 deg F x h x sq. ft./Btu at 75 deg F (5.2 K x sq. m/W at 24 deg C).

2.3 PERIMETER FOUNDATION INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
 - 1. Available Manufacturers:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company.
 - c. Owens Corning.
 - d. Pactiv Building Products Division.
 - 2. Extruded Polystyrene Board: ASTM C578, Type IV, 1.60 lb/cu. ft. unless otherwise indicated, Square Edge; or approved equal and mastic. Use 2" thick by 24" wide by 96" long insulation, R-5 per inch, 25 psi minimum compressive strength, "k" value of 0.1 maximum water absorption, 1.1 perm/inch maximum water vapor transmission for perimeter foundation insulation (not to be used inside the building). Maximum flame-spread rating 75, smoke-developed rating 450 or less as per ASTM E 84.

2.4 AUXILIARY INSULATING MATERIALS

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.
- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates and recommended and by the insulation manufacturer for the intended use.

- C. Insulation Fasteners: Product with demonstrated capability to fasten insulation securely to substrates indicated without damaging insulation and substrates and recommended and by the insulation manufacturer for the intended use.
- D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine substrate and conditions, under which insulation work is to be performed and must notify Contractor in writing of unsatisfactory conditions.
- B. Do not proceed with insulation work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

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 full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.
- E. 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.
- F. 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 PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.
- D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- 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. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder to warm-in-winter side of construction, unless otherwise indicated.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 - 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
 - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.

4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- E. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.
 1. Retain insulation in place by metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
 2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.
- F. Apply self-supported, spray-applied cellulosic insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make it flush with face of studs by using method recommended by insulation manufacturer.
- G. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

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.
- B. Prior to final close-in of all insulated areas, inspect same for damage, removals, voids or other defects, repair and renew all such areas to original condition.

END OF SECTION 072100

SECTION 072500 - WEATHER BARRIERS

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. Air barriers
 - 2. Flexible flashing

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For air barrier, include data on air and water-vapor permeance based on testing according to referenced standards.
- B. Evaluation Reports: For air barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 AIR BARRIER

- A. Air Barrier: Self-adhered sheet membrane air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Basis-of-Design: Grace Construction Products Ltd.; Perm-A-Barrier VPS.
 - 2. Water-Vapor Permeance: Not less than 15 perms per ASTM E 96, Desiccant Method (Procedure A).
 - 3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch water when tested according to ASTM E 2178.
 - 4. Allowable UV Exposure Time: Not less than 120 calendar days.

2.2 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Fully-Adhered Wall Flashing System consisting of 0.8mm of self-adhesive rubberized asphalt integrally bonded to 0.2mm of cross-laminated, high-density polyethylene film to provide a minimum 1.0mm thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed.
1. Performance Requirements:
 - a. Water Vapor Transmission: ASTM E96, Method B – 2.9ng/m²sPa (0.05perms) maximum.
 - b. Puncture Resistance: ASTM E154 – 356 N.
 - c. Tear Resistance: Initiation – ASTM D1004 – min. 58 N M.D.; Propagation – ASTM D1938 – min. 40 N M.D.
 - d. Lap Adhesion at -4°C – ASTM D1876 – 880 N/M of width.
 - e. Low Temperature Flexibility – ASTM D1970 – Unaffected to -45°F.
 - f. Tensile Strength – ASTM D412, Die C Modified – Min. 800 psi.
 - g. Elongation, Ultimate Failure of Rubberized Asphalt – ASTM D412, Die C – Min. 200%.
 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. Basis-of-Design: Grace Construction Products Ltd.; Perm-A-Barrier Wall Flashing.
- B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.
- C. Nails and Staples: ASTM F 1667.

2.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain air barrier, waterproofing, and flexible flashing materials from a single manufacturer regularly engaged in manufacturing waterproofing systems.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.

2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

C. Air Barrier: Comply with manufacturer's written instructions.

1. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 072500

SECTION 073113 - ASPHALT SHINGLES

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. Provide all labor, materials, accessories, equipment and incidentals to complete asphalt shingle roofing work as indicated and required including, but not necessarily limited to, the following:
 - 1. Asphalt shingles.
 - 2. Underlayment.
 - 3. Accessories, flashing and trim
 - 4. Snow Guards
- B. Related Sections:
 - 1. Division 06 Section "Rough Carpentry"
 - 2. Division 07 Section "Sheet Metal Flashing and Trim"
 - 3. Division 07 Section "Joint Sealants"
- C. Contractor will provide barricades as required, posting signs warning that men are working above, provide protection at entrances and other areas, etc., for people's protection.
- D. Work to be in strict compliance with currently adopted edition of OSHA Code, and Local and State requirements.

1.3 DEFINITION

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 REFERENCES

- A. American Society for Testing and Materials (ASTM) - Annual Book of ASTM Standards
 - 1. ASTM A 653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

3. ASTM B 370 - Standard Specification for Copper Sheet and Strip for Building Construction.
 4. ASTM D 2218 – Impact Resistance of Prepared Roof Covering Materials.
 5. ASTM D 3018 - Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules.
 6. ASTM D 3161 - Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method).
 7. ASTM D 3462 – Standard Specification for Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules.
 8. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
 9. ASTM D 7158 - Standard Test Method for Wind-Resistance of Sealed Asphalt Shingles (Uplift Force/Uplift Resistance Method).
 10. ASTM E 903 – Standard Test Method for Solar Absorptance, Reflectance, and Transmission of Materials Using Integrating Spheres.
- B. Underwriters Laboratories (UL) - Roofing Systems and Materials Guide (TGFU R1306)
1. UL 790 - Tests for Fire Resistance of Roof Covering Materials.
 2. UL 997 - Wind Resistance of Prepared Roof Covering Materials.
- C. Asphalt Roofing Manufacturers Association (ARMA)
- D. National Roofing Contractors Association (NRCA)

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed asphalt shingle roofing and flashings shall withstand specified wind speed ratings in accordance with IBC, International Building Code-2015, New Jersey edition, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Asphalt shingle roofing and flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for shingles, underlayment, leak-barrier underlayment, flashings, fasteners, and accessories indicating composition, properties and dimensions for each material and product used. Submit product test reports and data showing compliance with specified requirements.
- B. Shop Drawings: Submit shop drawings illustrating shingle layout, leak-barrier and flashing layout, method of attachment, details of flashing conditions, trim, conditions at eaves, intersections, penetrations and with adjacent materials, and other pertinent applicable installation details.

- C. Samples: For the following products, of sizes indicated, to verify color selected:
 - 1. Asphalt Shingle: Full size.
 - 2. Ridge (and Hip) Cap Shingles: Full size.
 - 3. Ridge Vent: 12-inch long Sample.
 - 4. Leak Protection: 12-inches square.
 - 5. Self-Adhering Underlayment: 12-inches square.
- D. Submit manufacturer's written installation instructions for each material and product used.
- E. Submit Manufacturer's maintenance and care instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer specializing in asphalt shingle roofing systems similar in material, design, and extent to that indicated for this Project having not less than 5 years experience and with a record of successful in-service performance. Installer shall have not less than five (5) roofing projects of size and complexity required for this project. Installer must be certified for installation of specified products to sufficient level to achieve specified warranties.
- B. Source Limitations: Obtain ridge and hip cap shingles ridge vents, leak-barrier, and synthetic underlayment, felt underlayment, from single source from single manufacturer.
- C. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108 or UL 790, for application and roof slopes indicated.
- D. Method of attachment shall be designed to adequately resist wind uplift for roof configuration and project location. Roof assembly shall be UL classified for wind uplift when tested at 120, MPH wind force in accordance with ASTM D 3161 and the IBC International Building Code 2015 New Jersey edition.
- E. Comply with requirements, guidelines, and recommendations of the following:
 - 1. Comply with fabrication details of "Architectural Sheet Metal Manual" by SMACNA.
 - 2. Comply with installation details of NRCA "Roofing and Waterproofing Manual".
 - 3. Comply with Class 1-90 Rating requirements for work related to roofing:
- F. Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the project site in un-opened containers, and bundles, etc., with clearly legible labels intact, including manufacturer's name, brand, product model/series name and other identifying information visible.
- B. Store roofing materials in a dry, well-ventilated, weather-tight location according to asphalt shingle manufacturer's written instructions and in a manner not to hinder building operation. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.
 - 1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.
- C. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installing asphalt shingle roofing system only when existing and forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements, and when substrate is completely dry.
- B. All surfaces must be dry and free of foreign materials, snow, ice, and any other condition, which would interfere with good application practice.
- C. Contractor shall be responsible to protect building from the elements at all times and will complete all work on a given area during a working day. No openings will be left in roof at end of day unless fully protected.

1.10 WARRANTY

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials within specified warranty period. Basis of Design Warranty is GAF Systems Plus Limited Warranty.
 - 1. Failures include, but are not limited to, the following:
 - a. Manufacturing defects.
 - b. Structural failures including failure of asphalt shingles to self-seal after a reasonable time.
 - 2. Material Warranty Period: 40 years from date of Substantial Completion, prorated, with first 20 years non-prorated.
 - 3. Wind-Speed Warranty Period: Asphalt shingles shall be tested in accordance with ASTM D 3161, Type I, and achieve Class F and be tested in accordance with ASTM D7158 to

- 150 mph and achieve Class H. Asphalt shingles will resist blow-off or damage caused by wind speeds up to 130 mph for 10 years from date of Substantial Completion.
4. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor 10 years from date of Substantial Completion.
 5. Workmanship Warranty Period: 20 years from date of Substantial Completion.

1.11 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. Asphalt Shingles: 20 sq. ft of each type, in unbroken bundles.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Laminated-Strip Asphalt Shingles: ASTM D 3462, heavyweight, architectural laminated style, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
 1. Basis-of-Design Product is Timberline Ultra HD Shingles, by GAF. UL 790 Class A rated with UL 997 Wind Resistant Label, ASTM D7158 Class H, ASTM D3161 Type 1, Energy Star Compliant. Subject to compliance with requirements, and Architect's approval, provide products of other manufacturer better than or equal to GAF.
 2. Starter Strip: Self sealing starter shingle: Basis of Design is ProStart Starter Strip by GAF.
 3. Butt Edge: Manufacturer's standard factory pre-cut edge matching the Basis-of-Design-Product.
 4. Strip Size: Manufacturer's standard.
 5. Algae Resistance: Granules treated to resist algae discoloration.
 6. Color and Blends: As indicated by manufacturer's designations or, if not indicated, as selected by Architect from manufacturer's full range of color and blends.
- B. Hip and Ridge Shingles: Manufacturer's standard high profile, self sealing units to match asphalt roof shingles. Basis of Design Timbertex Premium Ridge Cap Shingles by GAF, or approved equal.
- C. Vented Ridge: Manufacturer's standard vented ridge mesh. Basis of Design Cobra Exhaust Vent by GAF, or approved equal. Cap with Ridge Shingles as specified.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering Sheet Underlayment (Ice and Water Shield), Smooth Surfaced: ASTM D 1970, minimum of 55-mil thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; smooth

surfaced; with release paper backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment. Provide at all eaves, rakes, ridges, valleys, and area with penetrations. Basis of Design GAF Stormguard Leak Barrier, or approved equal.

- B. Underlayment: Premium, water repellant, breather type non-asphaltic underlayment. UV stabilized polypropylene construction. Meets or exceeds ASTM D226 and D4869. Install over entire roof area after installation of Stormguard Leak Barrier. Overlap leak barrier per manufacturer recommendations. Basis of Design is GAF Deck-Armor Premium Breathable Roof Deck Protection, or approved equal.

2.3 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.
- B. Roofing Nails: ASTM F 1667; Hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch diameter, barbed or ring shank, sharp-pointed, with a minimum 3/8-inch diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through OSB or plywood sheathing.
 - 1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Underlayment Nails: Hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch minimum diameter.
- D. Sealants: Equal to Dow 795 or approved equal.
- E. Traditional Pad Style Snow Guards: Gusseted snow guard for direct attachment to roof deck. Individual non-corrosive units consisting of strap, hood and gusset with a minimum of two fasteners per snow guard for mechanically fastening to roof deck at spacing shown and as recommended by the manufacturer.
 - 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, or approved equal:
 - a. Alpine Snow Guards, #PD40 snow guard (Basis-of-Design), Div. of Vermont Slate & Copper Services, Inc.
 - b. Berger Building Products, Inc.; Mullane BRONZE GUARD Series #100.
 - 2. Snow Guard Bracket: .032 aluminum.
 - 3. Fasteners: 302 or 304 stainless steel.
- F. Finish: Kynar 500 or Hylar 5000 pre-painted. Color: Black.

2.4 METAL FLASHING AND TRIM

- A. General: Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim."
 - 1. Sheet Metal: Stainless steel.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.
 - 1. Apron Flashings: Fabricate with lower flange a minimum of 5 inches over and 4 inches beyond each side of downslope asphalt shingles and 6 inches up the vertical surface.
 - 2. Step Flashings: Fabricate with a headlap of 2 inches and a minimum extension of 5 inches over the underlying asphalt shingle and up the vertical surface.
 - 3. Cricket Flashings: Fabricate with concealed flange extending a minimum of 24 inches beneath upslope asphalt shingles and 6 inches beyond each side of any chimney, skylight or curb and 6 inches above the roof plane.
 - 4. Drip Edges: Fabricate in lengths not exceeding 10 feet with 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge. Provide "D" style edge.
- C. Vent Pipe Flashings: ASTM B 749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 6 inches from pipe onto roof.

2.1 WOOD BLOCKING

- A. All wood blocking material, etc. to be of fir or hemlock, construction grade, of size as required for installation and Wolmanized pressure impregnated in accordance with AWPB LP-2 meeting Federal Specifications Standards TT-W-550 and T-W-551. Impregnated wood to be kiln dried or air seasoned to a moisture content of 15% or less, firmly secure with proper size galvanized nails. Provide material certification of compliance.

2.2 WOOD BLOCKING & CURBS

- A. Lumber: American Lumber Standard Committee (ALSC) No. 2 grade Southern Pine; free from warping and visible decay; Wolmanized pressure impregnated in accordance with AWPB LP-2 or pressure-treated according to AWPB Standard C2 for lumber and timber with CCA, ACA, ACQ-B, ACQ-D, ACZA, or CC to a retention of 4.0 kg/m³ (0.25 pcf) for above ground use.
- B. Plywood sheathing: APA C-D, Plugged & Touch Sanded, Fire Retardant Treated, Exposure 1, PS 1-83.
 - 1. Thickness: 3/4 inch.

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.
 - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
 - 2. Verify that substrate is sound, dry, smooth, free of fins and sharp edges, loose and foreign materials, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and penetrations through asphalt shingles.
- B. 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: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Contractor is responsible to provide necessary protection to the structure from the elements during the entire roofing process.
- C. Single-Layer Felt Underlayment (for roof slopes 4:12 and steeper): Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with felt underlayment roofing nails.
 - 1. Install fasteners at no more than 36 inch o.c.
- D. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below and as indicated on Drawings, lapped in direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.
 - 1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.
 - 2. Eaves: Extend from edges of eaves 24 inches minimum beyond interior face of exterior wall.
 - 3. Rakes: Extend from edges of rake 24 inches minimum beyond interior face of exterior wall.
 - 4. Valleys: Extend from lowest to highest point 18 inches on each side.
 - 5. Hips: Extend 18 inches on each side.

6. Ridges: Extend 36 inches. Do not cover the vent slot, or if no vent slot is provided, cut a 2" slot in nailable deck surface along the ridge, (1" on each side) for the entire length of the ridge ending 12 inches before the interior face of the exterior wall.
 7. Sidewalls: Extend beyond sidewall 18 inches, and return vertically against sidewall not less than 4 inches.
 8. Roof Slope Transitions: Extend 18 inches on each roof slope.
- E. Roof Protection: Install one layer of GAF roof deck protection over the entire area not protected by GAF leak barrier. Install sheets horizontally so water sheds and nail in place. On roofs sloped at more than 4 in 12, lap horizontal edges at least 2 inches and at least 2 inches over eaves protection membrane. Lap ends at least 4 inches. Stagger end laps of each layer at least 36 inches. Lap GAF roof deck protection over GAF leak barrier in valley at least 6 inches.

3.3 METAL FLASHING INSTALLATION

- A. General: Install metal flashings and other sheet metal to comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim."
1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."
- B. Apron Flashings: Extend lower flange over and beyond each side of down-slope asphalt shingles and up the vertical surface.
- C. Step Flashings: Install with a head-lap of 2 inches and extend over the underlying asphalt shingle and up the vertical surface. Fasten to roof deck only.
- D. Cricket and Backer Flashings: Install against the roof-penetrating element extending concealed flange beneath upslope asphalt shingles and beyond each side.
- E. Rake Drip Edges: Install rake drip edge flashings over underlayment and fasten to roof deck.
- F. Eave Drip Edges: Install eave drip edge flashings below underlayment and fasten to roof sheathing.
- G. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.
- H. Install gaskets, vents, joint fillers, closures, and sealants where indicated and required for a weather proof system. Provide types of gaskets, closures, sealants and fillers as recommended by the manufacturers.

3.4 ASPHALT SHINGLE INSTALLATION

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."
- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with no tabs or tabs removed at least 7 inches wide with self-sealing strip face up at roof edge.
 - 1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.
 - 2. Install starter strip along rake edge.
- C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern, for the shingles being installed, at succeeding courses, maintaining uniform exposure.
- D. Fasten asphalt shingle strips with a minimum of six roofing nails located according to manufacturer's written instructions. Do not drive nail heads into shingles.
 - 1. Where roof slope exceeds 20:12, seal asphalt shingles with asphalt roofing cement spots and after fastening with additional roofing nails when recommended by the roofing manufacturer's written installation instructions.
 - 2. Where roof slope is less than 4:12, seal asphalt shingles with asphalt roofing cement spots.
 - 3. When ambient temperature during installation is below 50 deg F, seal asphalt shingles with asphalt roofing cement spots.
- E. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- F. Ridge (and Hip) Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing. Do not drive nail heads into shingles.
 - 1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.
- G. Snow Guards: Install snow guards on all sloped roof surfaces to protect against snow and ice damage below.
- H. Replace any damaged materials installed under this section.

END OF SECTION 073113

SECTION 074646 - FIBER-CEMENT SIDING

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 fiber-cement siding and soffit.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
 - 2. Section 072500 "Weather Barriers".

1.3 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each type, color, texture, and pattern required.
 - 1. 12-inch long-by-actual-width Sample of siding.
 - 2. 24-inch wide-by-36-inch high Sample panel of siding assembled on plywood backing.
 - 3. 12-inch- (300-mm-) long-by-actual-width Sample of soffit.
 - 4. 12-inch long-by-actual-width Samples of trim and accessories.
- C. Product Certificates: For each type of fiber-cement product.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- E. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.
- F. Sample Warranty: For special warranty.

- G. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an installer with not less than 3-years of experience with products specified or having received credentials from Manufacturer's establishing them as a certified installer of the product.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking, fading and deforming.
 - b. Deterioration of materials beyond normal weathering.
 - 2. Warranty Period for Siding: 25 years from date of Substantial Completion.

1.8 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. Furnish full lengths of fiber-cement siding and soffit including related accessories, in a quantity equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie; HardiePlank Lap Siding, HardiePanel Vertical Siding, and HardieTrim Boards.
- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness: Not less than 5/16 inch.
- D. Horizontal Pattern: Boards 6-1/4 to 6-1/2 inches wide in plain style.
 - 1. Texture: Cedar mill.
- E. Factory Priming: Manufacturer's standard acrylic primer.
- F. Finish Colors: Manufacturer's factory-finished 'ColorPlus®' technology.
 - 1. FC-1: Arctic White – JH10-20

2.3 FIBER-CEMENT SOFFIT AND TRIM BOARDS

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie; HardiSoffit Panels and HardieTrim Boards.
- B. Nominal Thickness: Not less than 5/16 inch (8 mm).
- C. Pattern: 12-inch- (300-mm-), 16-inch- (400-mm-), or 24-inch- (600-mm-) wide sheets with smooth texture.
- D. Ventilation: Provide perforated soffit.
- E. Factory Priming: Manufacturer's standard acrylic primer.
- F. Finish Colors: Manufacturer's factory-finished 'ColorPlus®' technology.
 - 1. FC-1: Arctic White – JH10-20

2.4 ACCESSORIES

- A. Siding Accessories: Refer to Section 062013 "Exterior Finish Carpentry" for exterior cellular PVC trim and accessories including but not limited to starter strips, edge trim, outside and inside corner caps, and other items as required for a complete installation or as otherwise indicated on the drawings.
- B. Caulks & Sealants: Provide manufacturer's color matched sealants to match adjacent siding colors. Sealants shall be an elastomeric joint sealant complying with ASTM C920, Grade NS, Class 25 or higher, or a Latex Joint Sealant complying with ASTM C834. Apply caulks and sealants in accordance with the manufacturer's written instructions.
- C. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated on drawings.
 - 1. Finish for Aluminum Flashing: Siliconized polyester coating to match siding and/or trim as determined by the Architect.
- D. Fasteners:
 - 1. For fastening to wood, use siding nails or ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch into substrate.
 - 2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
 - 3. For fastening fiber cement, use stainless-steel fasteners.
- E. Insect Screening for Soffit Vents: PVC-coated, glass-fiber fabric, 18-by-14 or 18-by-16 (1.4-by-1.8- or 1.4-by-1.6-mm) meshes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and board-and-batten assemblies and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Install siding to dry surfaces.
- C. Repair any tears or punctures of weather barriers prior to the installation of siding.

- D. Coordinate installation of siding with flashings, trims and other adjoining construction to ensure proper sequencing.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Do not install damaged components.
 - 2. Install fasteners no more than 24 inches o.c. or as recommended by the siding manufacturer's written literature for the specific application/installation.
- B. Install joint sealants as specified in Section 079200 "Joint Sealants" or as otherwise detailed in this section to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manufactured through-wall flashing with counterflashing.
 - 2. Gutters and downspouts.
 - 3. Formed wall sheet metal fabrications.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leak-proof, secure, and noncorrosive installation.

1.4 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. FM Approvals' Listing: Manufacture and install roof-edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification. Identify materials with FM Approvals' markings. Wind Load: Total roof system installation, including Sheet Metal Flashing and Trim Work, shall be in conformance with FM 4450, FM 4470, UL 580 or UL 1890.
- C. Fabricate and install roof flashing capable of resisting forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 applicable to the Project site location.
- D. SPRI Wind Design Standard: Manufacture and install roof flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: Per IBC-2015, New Jersey Edition, Chapter 16.
 - E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base 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.
 - F. Comply with Applicable Requirements of the following:
 1. Class 1-90 Rating: Provide Roof Specialties Work in conformance with Class 1-90 requirements and coordinated with built-up roofing system and component materials which have been evaluated by an accredited test laboratory to have a Class 1-90 rating.
- 1.5 SUBMITTALS
- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
 - B. Shop Drawings: For sheet metal flashing and trim.
 1. Include plans, elevations, sections, and attachment details.
 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 6. Include details of termination points and assemblies.
 7. Include details of roof-penetration flashing.
 8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 9. Include details of connections to adjoining work.
 10. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches (1:10).
 - C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
 - D. Samples for Verification: For each type of exposed finish.
 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.

2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Gutters and Downspouts: 8 inches long, including liners, screens, straps, hangers, and other support and attachment devices.
4. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

E. Qualification Data: For fabricator.

F. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- B. SMACNA AND NRCA DETAILS: Conform work with details shown, and with fabrication requirements of "Architectural Sheet Metal Manual" by SMACNA. Comply with installation details of "Roofing and Waterproofing Manual" by NRCA.
- C. NRCA "Roofing and Waterproofing Manual", current edition. Material and installation specifications published by the insulation and membrane manufacturers.
- D. 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.
- E. Installer Qualifications: Engage an experienced Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 1. Exposed Coil-Coated Finish:
 - a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Color and Gloss: as selected by Architect from full range of available standard and premium colors.
- C. Stainless-Steel Sheet: ASTM A 240 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. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt; non-perforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D 226 for Type I and Type II felts.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal

temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

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

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal 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. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Hohmann & Barnard, Inc.
 - d. Or approved equal.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, non-expansion type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- F. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.
- G. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.
 - 1. Fabricate from the following materials:
 - a. Aluminum: 0.050 inch thick, minimum.

- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
 - 1. Hanger Style: U shaped 2" conductor pipe band (clinchier).
 - 2. Aluminum: 0.050 inch thick, minimum.

2.7 PIPE PORTALS

- A. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.

2.8 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch long, but not exceeding 12-foot long, sections, under 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: 0.016 inch thick, minimum.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch thick, minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.
- D. Apply slip sheet, wrinkle free, over underlayment or directly on substrate before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners[, solder], protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION REQUIREMENTS

- A. General: Except as otherwise indicated, comply with manufacturer's written installation instructions and recommendations, and with SMACNA "Architectural Sheet Metal Manual." The installer shall comply with manufacturers approved written installation guidelines, and recommended guidelines of SMACNA and the NRCA when setting and installing sheet metal flashing and trim components. Anchor units of work securely to structural substrates to withstand lateral and thermal stresses and inward and outward loading pressures, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints and seams that will be permanently watertight and weatherproof. All to be in compliance with manufacturer's recommendations and requirements.
- B. Isolation: Where metal surfaces of units contact dissimilar metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces or provide other permanent separation as recommended by aluminum producer.
- C. Expansion Provisions: Install running lengths to allow controlled expansion for movement of metal components in relation not only to one another but also to adjoining dissimilar materials, including flashing and roofing membrane materials, in a manner sufficient to prevent water leakage, deformation, or damage.

- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws and/or metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. 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.
- F. Underlayment: Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a slip sheet of red rosin paper and a course of polyethylene underlayment.
- G. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.
- H. Nail flanges of expansion joint units to curb nailers, at maximum spacing of 6" o.c. Fabricate seams at joints between units with minimum 3" overlap, to form a continuous, waterproof system.

3.5 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA and NRCA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets, straps, and twisted straps spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
 - 1. Fasten gutter spacers to front and back of gutter.
 - 2. Loosely lock straps to front gutter bead and anchor to roof deck.
 - 3. Anchor and loosely lock back edge of gutter to continuous cleat, eave or apron flashing.
 - 4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
 - 5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 1-1/2-inch telescoping joints.
 - 1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.

3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of

wall flashing with installation of wall-opening components such as windows, doors, and louvers.

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 indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants. Clean and neutralize flux materials. Clean off excess solder.
- C. 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 079200 - JOINT SEALANTS

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 joint sealants for the following applications:
 - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints.
 - b. Joints in masonry.
 - c. Perimeter joints of frames of doors, windows and louvers.
 - d. Other joints as indicated.
 - 2. Exterior joints in the following horizontal traffic surfaces:
 - a. Control, expansion, Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Other joints as indicated.
 - 3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings.
 - c. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls and partitions.
 - d. Perimeter joints between interior wall surfaces of frames of interior doors, windows and elevator entrances.
 - e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - f. Other joints as indicated.
 - 4. Interior joints in the following horizontal traffic surfaces:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in flooring.
 - c. Other joints as indicated.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 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 type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

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 (5 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
 - 5. FM 200 Suppression System: When an FM 200 fire suppression system is specified in any room in the building, all openings and penetrations must be sealed to establish an "air tight room".

1.1 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric 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: Five years from date of Substantial Completion.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles or approved equal.

2.2 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 sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Nonmembrane Roof Sealants: 300 g/L.
 - 3. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 4. Sealant Primers for Porous Substrates: 775 g/L.
 - 5. Modified Bituminous Sealant Primers: 500 g/L.
- C. Colors of Exposed Joint Sealants: For each locations and adjoining materials, color as selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric 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.
- C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Single-Component, Mildew-Resistant, Neutral-Curing, Silicone Sealant for use at plumbing fixtures:
 - 1. Available Products or approved equal:
 - a. Pecora Corporation; 898 VOC 12 g/L.
 - b. Sonneborn, Div of BASF; Omniplus, VOC 0 g/L.
 - c. Tremco; Spectrem, VOC 8 g/L.
 - 2. ASTM C920, Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 25/50.
 - 4. Use Related to Exposure: NT (nontraffic).
- F. Multi-Component, Nonsag, Polyurethane Sealant for exterior joints:
 - 1. Available Products:
 - a. Pecora Corporation; Dynatrol II, VOC 14 g/L.
 - b. Sonneborn, Div of BASF; 150, VOC 28 g/L.
 - c. Tremco; Dymeric 240/240 FC, VOC 35/5 g/L.
 - 2. ASTM C920, Type and Grade: M (multicomponent) and NS (nonsag).
 - 3. Class: 50.
 - 4. Use Related to Exposure: NT (nontraffic), M, A, G and O.
- G. Multi-Component, Self Leveling, Polyurethane Sealant: Use in Joints subject to traffic and for Radon abatement sealing of concrete slabs and concrete slab to block walls.
 - 1. Available Products:

- a. Pecora Corporation; Urexpam NR-200, VOC 0 g/L.
 - b. Sonneborn, Div of BASF; Sonolastic SL-2, VOC 0 g/L.
 - c. Tremco; THC 900/THC901, VOC 90/105 g/L.
 2. ASTM C920, Type and Grade: M (multicomponent) and P (pourable).
 3. Class: 25.
 4. Use Related to Exposure: SL, Traffic Grade
- H. Single-Component, Nonsag, Silicone Sealant for interior fire rated applications in accordance with appropriate UL Design Systems:
1. Available Products:
 - a. Pecora Corporation; 864, VOC 12 g/L.
 - b. Sonneborn, Div of BASF; Omniseal 50, VOC 35 g/L.
 - c. Tremco; Spectrem 4TS, VOC 18 g/L.
 2. ASTM C920, Type and Grade: S (multicomponent) and NS (nonsag).
 3. Class: 50.
 4. Use Related to Exposure: NT (nontraffic), Fire Rated Systems.

2.4 LATEX JOINT SEALANTS

- A. Single-Component, Non-Sag, Acrylic Latex Sealant for interior and acoustical joints: Comply with ASTM C 834, Type P, Grade NF.
1. Available Products:
 - a. Pecora Corporation; AC-20+, VOC 31 g/L.
 - b. Sonneborn, Div of BASF; Sonolac, VOC 41 g/L.
 - c. Tremco; Tremflex 834, VOC 11 g/L.
 2. ASTM C 834, Type and Grade: Type P, Grade NF.
 3. Class: 7.5/7.5
 4. Use Related to Exposure: General Purpose interior and exterior with slight to moderate movement.

2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type 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 B (Cylindrical flexible sealant backer rod with bi-cellular material with non-absorbing outer skin), non-gassing, non-exuding, chemically inert, non-absorbing, for cold applied sealants and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests and complying with VOC limits indicated.
- 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. 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, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable

of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on 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 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 type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform

beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
2. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 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.

3.5 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 079200

SECTION 081743 – FRP FLUSH DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Fiberglass reinforced polyester (FRP) flush doors with aluminum frames.
 - 2. Louvers

- B. Related Requirements:

- 1. Rough Carpentry: Division 06.
 - 2. Joint Sealants: Division 07.
 - 3. Door Hardware: Division 08.

1.3 REFERENCES

- A. AAMA 1503-98 - Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- B. ANSI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing.
- C. ASTM Tests:
 - 1. ASTM B 117 - Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.
 - 3. ASTM B 221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 4. ASTM D 256 - Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
 - 5. ASTM D 543 - Evaluating the Resistance of Plastics to Chemical Reagents.
 - 6. ASTM D 570 - Water Absorption of Plastics.
 - 7. ASTM D 638 - Tensile Properties of Plastics.
 - 8. ASTM D 790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 9. ASTM D 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes.

10. ASTM D 1621 - Compressive Properties of Rigid Cellular Plastics.
11. ASTM D 1623 - Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
12. ASTM D 2126 - Response of Rigid Cellular Plastics to Thermal and Humid Aging.
13. ASTM D 2583 - Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
14. ASTM D 5420 – Impact Resistance of Flat Rigid Plastic Specimens by Means of a Falling Weight.
15. ASTM D 6670-01 - Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products.
16. ASTM E 84 - Surface Burning Characteristics of Building Materials.
17. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
18. ASTM E 283 - Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
19. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
20. ASTM E 331 - Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
21. ASTM F 476 - Security of Swinging Door Assemblies.
22. ASTM F 1642-04 – Standard Test Method for Glazing Systems Subject to Air blast Loading.

D. NWWDA T.M. 7-90 – Cycle Slam Test Method.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.
- B. Air Infiltration: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 283 at pressure differential of 6.27 psf. Door shall not exceed 0.58 cfm/ft².
- C. Water Resistance: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 331 at pressure differential of 7.50 psf. Door shall not have water leakage.
- D. Blast Test, Doors and Frames, ASTM F 1642-04, 6 psi / 41 psi-msec: Minimal Hazard.
- E. Swinging Door Cycle Test, Doors and Frames, ANSI A250.4: Minimum of 25,000,000 cycles.
- F. Cycle Slam Test Method, NWWDA T.M. 7-90: Minimum 5,000,000 Cycles.
- G. Swinging Security Door Assembly, Doors and Frames, ASTM F 476: Grade 40.
- H. Salt Spray, Exterior Doors and Frames, ASTM B 117: Minimum of 500 hours.
- I. Sound Transmission, Exterior Doors, STC, ASTM E 90: Minimum of 25.

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- J. Thermal Transmission, Exterior Doors, U-Value, AAMA 1503-98: Maximum of 0.29 BTU/hr x sf x degrees F. Minimum of 55 CRF value.
- K. Surface Burning Characteristics, FRP Doors and Panels, ASTM E 84:
 - 1. Flame Spread: Maximum of 200, Class C.
 - 2. Smoke Developed: Maximum of 450, Class C.
- L. Surface Burning Characteristics, Class A Option On Interior Faces of FRP Exterior Panels and Both Faces of FRP Interior Panels, ASTM E 84:
 - 1. Flame Spread: Maximum of 25.
 - 2. Smoke Developed: Maximum of 450.
- M. Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 256: 14.0 foot-pounds per inch of notch.
- N. Tensile Strength, FRP Doors and Panels, Nominal Value, ASTM D 638: 13,000 psi.
- O. Flexural Strength, FRP Doors and Panels, Nominal Value, ASTM D 790: 21,000 psi.
- P. Water Absorption, FRP Doors and Panels, Nominal Value, ASTM D 570: 0.20 percent after 24 hours.
- Q. Indentation Hardness, FRP Doors and Panels, Nominal Value, ASTM D 2583: 55.
- R. Gardner Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 5420: 120 in-lb.
- S. Abrasion Resistance, Face Sheet, Taber Abrasion Test, 25 Cycles at 1,000 Gram Weight with CS-17 Wheel: Maximum of 0.029 average weight loss percentage.
- T. Stain Resistance, ASTM D 1308: Face sheet unaffected after exposure to red cabbage, tea, and tomato acid. Stain removed easily with mild abrasive or FRP cleaner when exposed to crayon and crankcase oil.
- U. Chemical Resistance, ASTM D 543. Excellent rating.
 - 1. Acetic acid, Concentrated.
 - 2. Ammonium Hydroxide, Concentrated.
 - 3. Citric Acid, 10%.
 - 4. Formaldehyde.
 - 5. Hydrochloric Acid, 10%.
 - 6. Sodium hypochlorite, 4 to 6 percent solution.
- V. Compressive Strength, Foam Core, Nominal Value, ASTM D 1621: 79.9 psi.
- W. Compressive Modulus, Foam Core, Nominal Value, ASTM D 1621: 370 psi.
- X. Tensile Adhesion, Foam Core, Nominal Value, ASTM D 1623: 45.3 psi.

- Y. Thermal and Humid Aging, Foam Core, Nominal Value, 158 Degrees F and 100 Percent Humidity for 14 Days, ASTM D 2126: Minus 5.14 percent volume change.

1.5 SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction, components, fabrication, finishes, and installation, reinforcement blocking for hardware and trim for openings.
- B. 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 for louvers.
- C. Shop drawing schedules shall list door numbers identical to those shown on the Architectural drawings.
- D. Samples:
 - 1. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.
 - 2. Color: Submit manufacturer's samples of standard colors of doors and frames.
- E. Sample Warranty: For special warranty.
- F. Test Reports: Submit certified test reports from qualified independent testing agency indicating doors comply with specified performance requirements.
- G. Manufacturer's Project References: Submit list of successfully completed projects including project name and location, name of architect, and type and quantity of doors manufactured.
- H. Maintenance Manual: Submit manufacturer's maintenance and cleaning instructions for doors, including maintenance and operating instructions for hardware.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body and is a certified participant in AWI's Quality Certification Program.
- B. Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of ten (10) years successful experience.
- C. Door and frame components from same manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finish from damage during handling and installation.

1.8 WARRANTY

- A. Warrant doors, frames, and factory hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.
- B. Warranty Period: Ten years starting on date of shipment. In addition, a limited lifetime (while the door is in its specified application in its original installation) warranty covering: failure of corner joinery, core deterioration, delamination or bubbling of door skin.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirement, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1. Special-Lite, Inc. SL-17 Flush Doors with Spec Lite 3 fiberglass reinforced polyester (FRP) face sheets.
 - 2. CECO Door Products.
 - 3. Curries Company.
 - 4. Or approved equal.

2.2 FRP FLUSH DOORS

- A. Construction:
 - 1. Door Thickness: 1-3/4 inches.
 - 2. Stiles and Rails: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes, minimum of 2-5/16-inch depth.
 - 3. Corners: Mitered.
 - 4. Provide joinery of 3/8-inch diameter full-width tie rods through extruded splines top and bottom integral to standard tubular shaped stiles and rails reinforced to accept hardware as specified.

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5. Securing Internal Door Extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.
6. Furnish extruded stiles and rails with integral reglets to accept face sheets. Lock face sheets into place to permit flush appearance.
7. Rail caps or other face sheet capture methods are not acceptable.
8. Extrude top and bottom rail legs for interlocking continuous weather bar.
9. Meeting Stiles: Pile brush weatherseals. Extrude meeting stile to include integral pocket to accept pile brush weatherseals.
10. Bottom of Door: Install bottom weather bar with nylon brush weatherstripping into extruded interlocking edge of bottom rail.
11. Glue: Use of glue to bond sheet to core or extrusions is not acceptable.

B. Face Sheet:

1. Material: SpecLite3 FRP, 0.120-inch thickness, finish color throughout.
2. Protective coating: Abuse-resistant engineered surface. Provide FRP with SpecLite3 protective coating, or equal.
3. Texture: pebble.
4. Color: As selected by Architect from full range of manufacturer's colors.
5. Adhesion: The use of glue to bond face sheet to foam core is prohibited.

C. Core:

1. Material: Poured-in-place polyurethane foam.
2. Density: Minimum of 5 pounds per cubic foot.
3. R-Value: Minimum of 9.

D. Hardware:

1. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
2. Factory install hardware.

2.3 MATERIALS

A. Aluminum Members:

1. Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes: ASTM B 221.
2. Sheet and Plate: ASTM B 209.
3. Alloy and Temper: As required by manufacturer for strength, corrosion resistance.

B. Components: Door and frame components from same manufacturer.

C. Fasteners:

1. Material: Aluminum, 18-8 stainless steel, or other noncorrosive metal.
2. Compatibility: Compatible with items to be fastened.

3. Exposed Fasteners: Screws with finish matching items to be fastened.

2.4 FABRICATION

- A. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on the Drawings.
- B. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.
- C. Assembly:
 1. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
 2. Remove burrs from cut edges.
- D. Welding: Welding of doors or frames is not acceptable.
- E. Fit:
 1. Maintain continuity of line and accurate relation of planes and angles.
 2. Secure attachments and support at mechanical joints with hairline fit at contacting members.

2.5 ALUMINUM DOOR FRAMING SYSTEMS

- A. Tubular Framing:
 1. Size and Type: As indicated on the Drawings.
 2. Materials: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes, 1/8-inch minimum wall thickness.
 3. Applied Door Stops: 0.625-inch high, with screws and weatherstripping. Door stop shall incorporate pressure gasketing for weathering seal. Counterpunch fastener holes in door stop to preserve full metal thickness under fastener head.
 4. Frame Members: Box type with 4 enclosed sides. Open-back framing is not acceptable.
 5. Caulking: Caulk joints before assembling frame members.
 6. Joints:
 - a. Secure joints with fasteners.
 - b. Provide hairline butt joint appearance.
 7. Field Fabrication: Field fabrication of framing using stick material is not acceptable.
 8. Hardware:
 - a. Pre-machine and reinforce frame members for hardware in accordance with manufacturer's standards and hardware schedule.

9. Anchors:

- a. Anchors appropriate for wall conditions to anchor framing to wall materials.
- b. Door Jamb and Header Mounting Holes: Maximum of 24-inch centers.
- c. Secure head and sill members of transom, side lites, and similar conditions.

2.6 LOUVERS

A. Metal Louvers:

- 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. L & L Louvers.
 - b. Air Louvers Inc.
 - c. Anemostat; a Mestek company.
 - d. Hiawatha Incorporated.
- 2. Free Area: 1.5 sf.
- 3. Blade Type: Vision-proof, inverted Y.
- 4. Screen: Aluminum insect screen.
- 5. Dampers: Aluminum blades and frames mounted on inside.
- 6. Metal and Finish: Heavy-duty extruded aluminum with Class I, clear anodic finish, AA-M12C22A31.

2.7 HARDWARE

- A. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
- B. Hardware Schedule: As specified in Section 087100.
- C. Finish: As specified in Section 087100.

2.8 ALUMINUM FINISHES

- A. Anodized Finish: Class I finish, 0.7 mils thick. Color as selected from manufacturer's full selection of standard and custom colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected
- B. Examine doors and installed door frames, with Installer present, before hanging doors.
- C. 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.
- C. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.
- D. Set thresholds in bed of mastic and backseal.
- E. Install exterior doors to be weathertight in closed position.

3.3 ADJUSTING

- A. Adjust doors, hinges, and locksets for smooth operation without binding.

3.4 CLEANING

- A. Clean doors promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that would damage finish.

3.5 PROTECTION

- A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

END OF SECTION 081743

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
- B. Related Sections:
 - 1. Division 08 Section “FRP Doors”,
- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- D. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
- C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and

special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

- D. Electrified Hardware: Provide electrical information to include voltage, and amperage requirements for electrified door hardware and description of operation.
 - 1. Description of operation for each electrified opening to include description of component functions including location, sequence of operation and interface with other building control systems.
 - 2. Wiring Diagrams: Detail wiring for power, signal, and control system and differentiate between manufacturers installed and field installed wiring. Include the following:
 - a. System schematic.
 - b. Point to point wiring diagram.
 - c. Riser diagram.
 - d. Elevation of each door.
- E. Detail interface between electrified door hardware and fire alarm, access control, security, and building control systems.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.3 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. Electrified door hardware shall be Listed and Labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authority having jurisdiction.

- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service.

1.5 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.6 WARRANTY

- A. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner.
- B. Standard Warranty Period: Two year from date of Substantial Completion, unless otherwise indicated.
- C. Special Warranty Periods:
 - 1. Seven years for heavy duty cylindrical (bored) locks and latches.
 - 2. Twenty five years for manual surface door closer bodies.

1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

2.2 HANGING DEVICES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

- 1. Acceptable Manufacturers:
 - a. Pemko Manufacturing (PE).

2.3 DOOR OPERATING TRIM

- A. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

- 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
- 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
- 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
- 4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
- 5. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).

2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
 - 1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA).
- C. Cylinders: Original manufacturer cylinders complying with the following:
 - 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 - 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 5. Keyway: Match Facility Standard.
- D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 - 1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware. Provide removable core (small or large format) as specified in Hardware Sets.
- E. Security Cylinders: ANSI/BHMA A156.5, Grade 1, patterned security cylinders and keys able to be used together under the same facility master or grandmaster key system. Cylinders are to be factory keyed.
 - 1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - Signature Series.
- F. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. Existing System: Key locks to Owner's existing system.
- G. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Two (2)
 - 2. Master Keys (per Master Key Level/Group): Five (5).

3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).
5. Permanent Control Keys (where required): Two (2).

H. Construction Keying: Provide temporary keyed construction cores.

I. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.

1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
2. Locks are to be non-handed and fully field reversible.
3. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) – 10 Line.

2.6 AUXILIARY LOCKS

A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.

1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - 4870 Series.

2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 MAGNETIC LOCKS

A. Shall be of one manufacturer as listed for continuity of design and consideration of warranty. Manufacturer shall meet requirements for ANSI/BHMA A156.23 Grade 1 Compliant. Design:

1. Epoxy free, field upgradeable and repairable.
2. Interlocking mounting plate to secure wiring and mounting screws.
3. 1200 lb holding force.
4. Drop down plates or brackets and clear anodized.

B. Key switches

1. Single gang, wall mounted, recessed mortise cylinder.
2. Tamper resistance spanner screws.
3. 20 gauge stainless steel faceplate.
4. Momentary (MO); Timed actuation (1-60 seconds); Alternate action (on/off) (AA)

C. Exit Switches

1. 2 inches (51 mm) square button "PUSH TO EXIT" TS-2
2. Single gang, wall mounted, integrated electronic timer, fixed 30 seconds.
3. Momentary, SPDT.

D. Acceptable Manufacturer:

1. Alarm Controls - 1200S single

2.9 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) – DC6000 Series.
 - b. Sargent Manufacturing (SA) - 351 Series.
 - c. Norton Door Controls (NO) - 7500 Series.

2.10 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
2. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, .050-inch thick.

3. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
4. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).

2.11 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Acceptable Manufacturers: Rockwood Manufacturing (RO).

2.12 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
 1. Acceptable Manufacturers: Pemko Manufacturing (PE).

2.13 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.3 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.4 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.5 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.6 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. Manufacturer's Abbreviations:
 - 1. MK - McKinney
 - 2. PE - Pemko
 - 3. SA - Sargent
 - 4. RO - Rockwood
 - 5. AC - Alarm Controls

END OF SECTION 087100

SECTION 089119 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fixed, extruded-aluminum louvers.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide louvers capable of withstanding 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 on vertical projection of louvers.
 - 1. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft. (957 Pa) (1436 Pa)] acting inward or outward.
- B. Thermal Movements: Provide louvers 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, 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- C. Air-Performance, Water-Penetration, Air-Leakage, and Wind-Driven Rain Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- D. Airborne Sound Transmission Loss: Provide acoustical louvers complying with airborne sound transmission loss ratings indicated, as demonstrated by testing manufacturer's stock units identical to those specified, except for length and width according to ASTM E 90.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.
 - 1. For installed louvers and vents indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Wiring Diagrams: Power, signal, and control wiring for motorized adjustable louvers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of metal finish required.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents through one 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, "Structural Welding Code--Aluminum."
- 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 adjustable louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Louvers:
 - a. Airline Products Co.
 - b. Construction Specialties, Inc.
 - c. Greenheck.
 - d. Industrial Louvers, Inc.
 - e. Or approved equal

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 1. Use types and sizes to suit unit installation conditions.
 2. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 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. 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.

2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louver:
 - 1. Louver Depth: 4 inches (100 mm).
 - 2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch (2.0 mm) for blades and 0.080 inch (2.0 mm) for frames.
 - 3. Performance Requirements:
 - a. Free Area: Not less than 50%. for 48-inch- (1.2-m-) wide by 48-inch- (1.2-m-) high louver.
 - b. Point of Beginning Water Penetration: Not less than 900 fpm (4.6 m/s).
 - c. Air Performance: Not more than 0.15-inch wg static pressure drop at 900-fpm free-area velocity.
 - 4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.5 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening.
- B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) 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 for securing screen mesh.
- D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.063-inch (1.6-mm) wire.

2.6 BLANK-OFF PANELS

A. Uninsulated, Blank-off Panels:

1. Aluminum sheet for aluminum louvers, not less than 0.050-inch (1.2-mm) nominal thickness, unless otherwise indicated.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish louvers after assembly.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
 1. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: As selected by Architect from manufacturer's full range.

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.
 1. 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 galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 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 until final cleaning.
- 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.

END OF SECTION 10200

SECTION 092900 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. Provide all labor, materials, accessories, equipment, incidentals to complete gypsum board assembly work, as indicated and required including, but not necessarily limited to, the following:
 - 1. Interior Gypsum Board.
 - 2. Non-Load-Bearing Steel Framing and Furring.
 - 3. Accessories and Trim.
 - 4. Taping and Spackling.
 - 5. Reinforcing and blocking to receive and support the work of other trades.
 - 6. Built-in items furnished by other trades and/or contracts.

1.3 SUBMITTALS

- A. Submit manufacturer's product data and installation instructions for each type of product indicated.
- B. Shop Drawings showing layout, locations, fabrication, and installation of all control and expansion joints including plans, elevations, sections, and details of components and attachments of other units of work including concealed blocking.

1.4 QUALITY ASSURANCE

- A. Comply with the requirements of the following:
 - 1. ASTM C 474 "Standard Test Methods for Joint Treatment Materials for Gypsum Board Construction."
 - 2. ASTM C 475 "Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board."
 - 3. ASTM C 645 "Standard Specification for Nonstructural Steel Framing Members."
 - 4. ASTM C 754 "Standard Specification for Installation of Steel Framing Members to Receive Screw Attached Gypsum Panel Products."
 - 5. ASTM C 840 "Standard Specification for Application and Finishing of Gypsum Board."

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6. ASTM C 919 “Standard Specification for Use of Sealants in Acoustical Applications.”
 7. ASTM C 954 “Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inches to 0.112 in. in thickness.”
 8. ASTM C 1002 “Standard Specification for Specification for Steel Drill Screws for the Application of Gypsum Panel or Metal Plaster Bases.”
 9. ASTM C 1047 “Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.”
 10. ASTM C 1396 “Standard Specification for Gypsum Wallboard.”
 11. GA-216 “Recommend Specifications for the Application and Finishing of Gypsum Board.”
 12. GA-600 “Fire Resistance Design Manual.”
- B. Fire Resistance Ratings: As indicated by reference to GA File Numbers in GA-600 “Fire Resistance Design Manual,” to designations in UL “Fire Resistance Directory,” or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Sound Rated Assemblies: Provide materials and construction identical to assemblies indicated and in accordance with ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency to achieve the STC rating indicated, or if not indicated, a minimum STC Rating of 50.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original unopened containers, packages or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and in manner to keep them dry, protected from direct exposure to rain, snow, condensation, direct sunlight, surface contamination, corrosion, damage, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.
- C. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal corner beads and trim from being bent or damaged.

1.6 PROJECT CONDITIONS

- A. Comply with ASTM C 840 requirements gypsum board manufacturer's written recommendations, whichever are more stringent, for environmental conditions before, during and after application of gypsum board construction work.
- B. Environmental Limitations: Room temperatures shall be maintained at not less than 50 degrees F, during application of gypsum board for a minimum period of 48 hours prior to, during and following application of gypsum board, joint treatment materials and bonding of adhesives.

- C. Further maintain not more than 80 degrees F for 7 days prior to application of gypsum base, continuously during application, and after application until plaster skim coat is dry.
- D. Avoid exposure to excessive, repetitive or continuous moisture, before, during, and after installation. Eliminate sources of moisture immediately
- E. Ventilation: Adequate ventilation shall be maintained in the work area of building spaces as required to remove water in excess of that required for drying of joint treatment material and plaster skim coat during installation and curing period. Avoid drafts during dry, hot weather to prevent too rapid drying.
- F. Do not install interior gypsum panels until installation areas are enclosed and conditioned.
- G. Do not install panels that are wet, 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.
- H. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following or approved equal.
 - 1. Metal Support Materials:

Dale/Incor, Inc.
National Gypsum Co.
Dietrich Industries, Inc.
 - 2. Gypsum Board and Related Products:

Georgia-Pacific Corp.
National Gypsum Company, Gold Bond Building Products Div.
United States Gypsum Co.

2.2 STEEL FRAMING

- A. Metal Studs: ASTM C645; 0.0329 (20 gauge) min. thickness of base metal unless otherwise indicated. Hot dipped galvanized per ASTM A 653, G 40, (G60 at showers, toilet rooms, and other interior locations subject to high humidity, steam and water).

1. Depth of Section: 3-5/8", or as otherwise indicated.
 2. Runners: Match studs; type recommended by stud manufacturer for floor and ceiling support of studs, and for vertical abutment of drywall work at other work.
- B. Furring Members: ASTM C645; 0.0179 (25 gauge) hat-shaped. Face width, 1-1/4" with 7/8" depth. Designed for screw attachment. Hot dipped galvanized per ASTM A 653, G 40, (G60 at showers, toilet rooms, and other interior locations subject to high humidity, steam and water).
- C. Fasteners for Metal Framing: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

2.3 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide panels in maximum lengths and widths available that will minimize joints in each area and correspond with the support system indicated.
- B. All Gypsum Wallboards: ASTM C-1396; tapered edges, Type X for fire resistance rated assemblies.
1. Water-Resistant Gypsum Wallboard for use at toilet rooms: 5/8" thick, unless otherwise indicated, manufactured with a special water resistant core and faced with chemically treated multi-layered face and back papers to combat moisture penetration, with long ends tapered, green finish paper. Use Type X where required for fire resistance rated assemblies.
 2. Interior Gypsum Board Ceiling (GBC): 1/2" thick, unless otherwise indicated, manufactured with a special gypsum core containing additives to offer greater support and sag resistance for water based spray texture paints and insulation than 5/8" standard regular-type panels. Use Type X where required for fire resistance rated assemblies.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047. Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of electro-galvanized steel 28 gage minimum unless otherwise indicated with either knurled and perforated or expanded flanges for nailing or screwing and beaded for concealment of flanges in joint compound.
1. Provide corner beads at outside corners, LC-Beads (J-Bead) at exposed panel edges, L-Beads, U-Beads, special L-kerf-type edge trim beads and one-piece expansion (control) joint beads.

2.5 JOINT TREATMENT MATERIALS

- A. Joint Treatment Materials: Comply with ASTM C 475 and recommendations of manufacturer.
- B. Joint tape:

1. Use perforated paper type for interior wallboard and exterior gypsum ceiling board. Use 10-by-10 glass mesh for glass mat gypsum sheathing board and veneer plaster base panels with plaster bonder.
- C. Joint compound: Comply with ASTM C 475 and recommendations of the manufacturer.
 1. For interior gypsum wallboard, use setting-type taping compound followed by coats of setting-type sandable topping compound or as otherwise recommended by manufacturer.

2.6 AUXILIARY MATERIALS

- A. Fastening Adhesive for Wood: ASTM C 557.
- B. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum panels to steel framing.
- C. Steel Drill Screws: ASTM C 1002
- D. Framing screws: ASTM C 646 - Corrosion Resistant
- E. Power actuated fasteners: Type recommended by manufacturer for securing runners and furring strips to masonry and concrete.
- F. Steel drill screws: ASTM C 954 - Corrosion Resistant for fastening panels to steel members.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine the areas and conditions under which gypsum board assembly work is to be installed and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 METAL SUPPORT

- A. Comply with specified standards.
- B. Furring Channels: Space maximum 16" o/c, unless otherwise indicated, and at not more than 4" from floor and ceiling lines or abutting walls, Secure in place 24" o/c on alternate flanges.
- C. Install Framing, bracing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, etc., whether shown or not, as required to provide a complete, rigid, stable and structurally sound installation.

- D. Install supplementary framing and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, handrails, grab bars, accessories, furnishings, otherwise indicated, to comply with applicable published recommendations of gypsum board manufacturer and "Gypsum Construction Handbook" published by United States Gypsum Co.
- E. Install auxiliary framing at termination of drywall work, and at openings, as required for support of both the drywall construction and other work indicated for support thereon.
- F. Drywall to Acoustical transition: To form a transition from a drywall ceiling to an acoustical ceiling, use Drywall Transition Clips which allows use of the grid as a transitional trim.
- G. Provide additional framing and blocking to build in and support items furnished in other Sections and other Contracts.

3.3 WALLBOARD INSTALLATION

- A. Installation of gypsum board products shall be in accordance with ASTM C 840 "Standard Specification for Application and Finishing of Gypsum Board".
- B. Inspect all surfaces and framing to which gypsum wallboard is to be applied. Remedy all conditions that will jeopardize satisfactory finish walls prior to installation of drywall. Check alignment and plumb of all framing and furring. Insulation will be double layer of wallboard unless noted otherwise.
- C. Install appropriate gypsum panel perpendicular to the framing and up against the floor and metal deck. Use the correct type and length of fastener, including spacing to meet the intended fire resistance rating. Install panels on both sides of the metal framing unless otherwise indicated.
- D. Install gypsum soffit and ceiling boards across framing to minimize the number of abutting end joints and avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panel's not less than one framing member.
- E. Install single layer wallboard assemblies horizontally with Type "S" Bugle head drywall screws spaced not more than 12" o.c. Stagger joints on both sides of two sided partitions. Tightly install sound or thermal batt insulation as indicated between studs. Run three continuous beads of caulking at top of beam prior to installing wallboard. Butt boards together for a light contact at edges and ends with not more than 1/16" open space between boards. Do not force into place.
- F. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut field-cut ends against mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions. Provide temporary bracing as required until fully adhered.
- G. Install gypsum board with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16-inch open space between panels. Do not force into place.

- H. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories. Spacing of control and expansion joints shall be as shown and/or in accordance with the gypsum board manufacturer's written recommendations.
- I. Install in maximum practical lengths to span wall and ceiling framing without end (butt) joints. If butt joints do occur, stagger joints and locate as far as possible from center of walls and ceilings.
- J. Cut openings in gypsum board to fit items to be built in, including electrical outlets, accessories, etc. Openings shall fit snugly and shall be small enough to be covered by plates and escutcheons. Both face and back paper shall be cut for all cutouts that are not made by use of a saw. Support gypsum board securely around all cutouts and openings.
- K. Allow the other trades to install the needed services (MEP) through the first layer of gypsum board.
- L. Install all required through stop penetrations. Continue installing the remaining gypsum panels to complete the wall in accordance with the fire rated design.
- M. Install fasteners not more than 1" and no closer than 3/8" to end or edges. Space fasteners opposite each other on adjacent ends or edges. Begin fastening from center of wallboard and proceed toward outer end of edges. Apply pressure on wallboard adjacent to fasteners being driven to ensure that wallboard will be secured tightly to framing members. Check for looseness at fastener. Drive fasteners with shank reasonably perpendicular to face of board. Drive screws with a power screwdriver of type recommended by the wallboard manufacturer. Surface of head shall be below surface of paper without cutting paper.

3.4 ACCESSORY INSTALLATION

- A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by nailing or stapling in accordance with manufacturer's instructions and recommendations.
- B. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where semi-finishing type is indicated. Install L-type trim where work is tightly abutted to other work, and install special kerf-type where other work kerfed to receive long leg of L-type trim. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).
- C. Install J-type semi-finishing trim where gypsum board edges are not covered by applied moldings.
- D. Omit fastening wallboard closer than one support away from area where casing trim will be installed. Insert metal flange between wallboard and bearing surface, and move in until properly aligned. Fasten wallboard through metal flange before bedding perforated tape.
- E. Maintain metal edge in a true line.

3.5 JOINT TREATMENT

- A. Apply bedding compound to edge and end joints and to fastener heads. Use types as recommended by gypsum manufacturer for use with gypsum product being installed. Shear off surplus leaving a tapered groove for embedding tape. Leave no material on high edge. Allow 12 hours for drying before taping.
- B. Apply a uniformly thin layer of bedding compound over the joint approximately 4" wide. Center tape over joints and embed into compound.
- C. Allow compound to dry thoroughly for approximately 24 hours. Cover tape with a coat of compound and spread out 3" on each side of tape. Feather out at edges.
- D. After preceding coat is thoroughly dry, apply another coat with slight uniform crown over joints. This coat must be smooth and with edges feathered out 3" beyond preceding coat.
- E. All fastener heads and dimples shall receive at least three (3) coats of compound. Apply as each coat is applied to joints, allowing at least 24 hours between each coat.
- F. Cover flanges of beads and trim with at least two (2) coats of compound. First layer shall be bedding compound. Apply along with respective coats of compound on joints. Feather out compound approximately 9" from metal bead.
- G. Sand coats of compounds when thoroughly dry and sanding is needed. Avoid roughing surface of gypsum board product.
- H. Leave wallboard uniformly smooth and ready for decoration.

3.6 PROTECTION OF WORK

- A. Provide temporary protection to installed panels, such as tarps, as required. The intent is to protect the gypsum panels in those areas where, when installed, exhibit increased potential for impingement by water in its liquid state. Protect from cascading water.
- B. Provide final protection and maintain conditions, in a manner suitable to installer, which ensures gypsum board assembly work being without damage or deterioration at time of substantial completion.

END OF SECTION 092900

SECTION 093000 - CERAMIC TILE

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 DESCRIPTION OF WORK

- A. Provide all labor, materials, accessories, equipment and incidentals to complete ceramic tile work as shown, specified, and as required for a complete installation including, but not necessarily limited to, the following:
 - 1. All necessary surface preparation and leveling of substrates.
 - 2. Wall Tile and Trims.

1.3 QUALITY ASSURANCE

- A. Provide materials obtained from one source for each type and color of tile, grout, and setting materials.
- B. Comply with ANSI A137-1 "American National Standard Specifications for Ceramic Tile" for types and grades of tile indicated. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- C. Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
- D. Conform to the requirements of the Tile Council of North America, "Handbook for Ceramic, Glass, and Stone Tile Installation", current edition.
- E. Static Coefficient of Friction: Floor tile shall have a static coefficient of friction greater than 0.6 in accordance with ANSI A-137.1 and ASTM C 1028 (wet).

1.4 SUBMITTALS

- A. Submit product data, properly identified manufacturer's literature giving material specifications, mortar and grout mixes and installation directions for approval.
- B. For initial selection purposes, submit manufacturer's color pallettes consisting of actual tiles or selections of tile showing full range of colors, textures and patterns available for each type of tile indicated. Include samples of grout and accessories requiring color selection. Colors shall be as indicated on drawings or approved equal provided that they blend in with the color

schemes selected for the overall project and are of equivalent price grouping as the selected colors.

1.5 DELIVERY AND STORAGE

- A. Deliver all packaged materials to the site in original, unopened containers, clearly indicating manufacturer's name, brand name, and other identifying information.
- B. Store materials in a dry location, off the ground, and in such a manner as to prevent damage or intrusion of foreign matter. Replace all materials that have become damaged or otherwise unfit for use, during delivery or storage.
- C. Deliver extra materials to Owner. Furnish extra materials that match products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
- D. Quantity of Tile and Trim Extra Materials: Provide 3% of each type, composition, color, pattern and size of tile installed on the project. Package in original manufacturer's protective wrapping and clearly identify each container, indicating its contents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide colors, patterns, borders, fields and designs as indicated, or if not indicated, as selected by the Architect from the manufacturer's full color range of colors for the products listed below as manufactured by American Olean, Crossville, DalTile or approved equal.
- B. Wall Tile:
 - 1. (12" x 12") or (12" x 24") x 5/16" glazed porcelain wall tile in colors and layout patterns as indicated on drawings, or if not indicated, as selected by the Owner from manufacturers full range.
- C. Accessory and Trim Tiles
 - 1. Provide accessory and trim tiles to match colors of wall tile as indicated. Field butt inside corners, bullnose out corners.
- D. Setting and Mortar Materials:
 - 1. Flexible Polymer modified Portland cement mortar; consisting of two components - liquid polymer and dry set mortar, Hydroment PM by Bostick or approved equal - conforming to A.N.S.I. A118.4 with the polymer having the following characteristics:

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2. Walls: Flexible polymer Latex Modified Portland Cement mortar, A.N.S.I. A118.4 as described above.
 3. Wall Grout: Latex Modified Cement Grout, A.N.S.I. A118.6 in colors as selected by Architect.
- E. Reinforced Portland Cement Mortar Setting Bed: ANSI A108.1b:
1. Metal Lath: ASTM A 185 and ASTM A 82, galvanized.
 2. Portland Cement: ASTM C 150 Type 1.
 3. Lime: ASTM C 206 Type S or ASTM C 207 Type S.
 4. Sand: ASTM C 144.
 5. Water: Potable.
- F. Penetrating Sealer/Grout Release: Of type and consistency as recommended by the manufacturer to prevent staining by grouts and reduce staining by waters and oils. Apply to tiles in strict accordance with manufacturer's written requirements.
- G. Tile Cleaner
1. Product specifically acceptable to manufacturer of tile and grout manufacturer for application indicated and as recommended by National Tile Promotion Federation, 112 North Alfred St., Alexandria, VA 22134 or Ceramic Tile Institute, 700 N. Virgil Ave., Los Angeles, CA 90029.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Examine substrates and areas where tile will be installed with installer present, for compliance with requirements for installation tolerances, square of layout and other conditions affecting performance of work. Report discrepancies to the Architect in writing prior to proceeding with work for resolution. Commencement of work indicates Contractor's acceptance of existing conditions and any corrective work thereafter will be corrected by the Contractor at no additional cost to the Owner.
- B. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
- C. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units or work, and similar items located in or behind tile has been completed before installing tile.

3.2 INSTALLATION

- A. Conform to the TCNA "Handbook for Ceramic, Glass, and Stone Tile Installation" and to the ANSI Specifications referenced therein.
- B. Comply with the manufacturer's instructions for mixing and installation of proprietary materials.
- C. Turn waterproof membrane up walls a minimum of 6" above finish floor level.
- D. Center design layout for fields, patterns, borders and designs on applied areas and so that no tile is less than half size. Start corner tile at half tile width minimum. Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor and base are the same size. Provide uniform widths. Design layout for fields, patterns, borders and designs shall be provided by time of submittal review by Architect.
- E. Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown.
- F. Terminate work neatly at obstructions, edges and corners without disrupting pattern of joint alignments.
- G. Cut and drill tile and trim shapes accurately without damage. Rub all exposed cut edges smooth with abrasive stone.
- H. Comply with recommendations of TCNA for location and design of expansion joints, if not shown on the drawings. Notify Architect of intended locations prior to beginning work.
- I. Press tile firmly into mortar and beat it to a true surface before initial set occurs. See that full contact is obtained to insure that there are no sizable voids. Adjust any tile that is out of alignment.
- J. Locate expansion joint and other sealant filled joints, including control, contraction and isolation joints, where indicated, or if not indicated, at spacing and locations recommended in TCNA "Handbook for Ceramic, Glass, and Stone Tile Installation", and approved by Architect.
- K. Grout tile is to comply with referenced installation standards, using grout materials indicated. Mix and install proprietary components to comply with grout manufacturer's directions.

3.3 SETTING METHODS

- A. Conform to the following listed setting methods described in the latest edition of the TCNA Handbook Specification.
- B. Ceramic Tile Walls:
 - 1. W243: In dry areas with limited water exposure, over water resistant gypsum board screwed to well braced studs, Latex-Portland cement mortar bond coat, Latex Modified Cement grout.

3.4 CURING

- A. Moist cure floor tile per TCNA recommendations. Cover floor with polyethylene sheets. Add water to surface on second day after setting and replace sheeting.

3.5 CLEANING AND PROTECTION

- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter. Cleaning materials, other than water, and methods must be specifically acceptable to the manufacturers of each tile, each grout, and the waterproofing/setting bed material and so indicated in manufacturer's printed instructions or approval on letterhead. Protect adjacent work. Flush with clean water before and after cleaning. Leave finished installations clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.
- B. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with Kraft paper or other heavy covering during construction period to prevent damage and wear.
- C. Prohibit foot and wheel traffic from using tiles floors for at least 3 days after grouting is completed. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 093000

SECTION 096723 - RESINOUS FLOORING

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 resinous flooring systems.
 - 1. Fluid-applied resinous flooring.
 - 2. Integral sanitary cove base.
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete".
 - 2. Section 035416 "Hydraulic Cement Underlayment".
 - 3. Section 079200 "Joint Sealants".

1.3 SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.
- C. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- D. Material Certificates: For each resinous flooring component, from manufacturer.
- E. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated with a minimum of (3) three years' experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials in a dry protected area at a temperature between 60°F and 80°F, unless otherwise recommended in writing by manufacturer.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period for curing.
- D. Coordinate work with other trades.
- E. Commence preparation and application after all other trades have completed their work.

1.7 WARRANTY

- A. Submit a written warranty, signed by the manufacturer and applicator, agreeing to repair or replace failures and defects in material and workmanship for a period of two (2) years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flammability: Self-extinguishing according to ASTM D 635.
- C. Static Coefficient of Friction: Greater than 0.6 for level surfaces in accordance with ASTM D2047.

2.2 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following or approved equal:
1. Dura-A-Flex, Dur-A-Quartz Q28 (Basis of Design).
 2. Palma, Inc.; PalmaLite-Palikrom 185.
 3. Key Resin Company, Key Quartz B-125.
 4. Dex-O-Tex, Décor-Flor.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.3 RESINOUS FLOORING

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- B. System Characteristics:
1. Color and Pattern: As selected by Architect on Drawings, Interior Finish Legend.
 2. Wearing Surface: Textured for slip resistance.
 3. Overall System Thickness: 1/8 inch.
- C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
1. Formulation Description: 100 percent solids.
- D. Vapor Retarder: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
1. Moistop by Fortifiber.
 2. Griffolyn by Reef Industries.
- E. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- F. Body Coats:
1. Resin: Epoxy.
 2. Formulation Description: 100 percent solids.
 3. Type: Clear.
 4. Application Method: Self-leveling slurry with broadcast aggregates troweled

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5. Number of Coats: Two (2).
 6. Thickness of Coats: As required to attain overall system thickness, but no less than 1/8 inch.
 7. Aggregates: Manufacturer's standard for the specified system.
- G. Topcoats: Sealing or finish coats.
1. Resin: Epoxy.
 2. Formulation Description: 100 percent solids.
 3. Type: Clear.
 4. Number of Coats: One.
 5. Finish: Orange Peel
- H. Aggregate: Q28 – Color quartz for color and texture.
- I. Silica Sands: 20/40 & 140 Mesh.
- J. Cove Caps: Provide stainless steel cove caps to top of integral cove base to match thickness of flooring system. Adhere caps to substrates per the manufacturer's recommendations at min. 4" heights or as indicated on the drawings. Mitre corners for neat transitions and grind outside corners to remove sharp edges.
- K. Divider Strips: Provide stainless steel divider strips at locations indicated on drawings to match thickness of flooring system. Adhere caps to substrates per the manufacturer's recommendations. Mitre corners at changes in direction.
- L. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
1. Compressive Strength: 12,500 psi minimum according to ASTM C 579.
 2. Tensile Strength: 2,600 psi minimum according to ASTM C 307.
 3. Flexural Modulus of Elasticity: 6,250 psi minimum according to ASTM D 790.
 4. Water Absorption: 0.04 percent maximum according to ASTM D 570.
 5. Waterproof: no evidence of moisture according to ASTM D-4068.
 6. Linear Expansion: 2×10^{-5} in./in./°F according to ASTM D 696.
 7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch permanent indentation according to MIL-D-3134.
 8. Abrasion Resistance: 24 mg maximum weight loss according to ASTM D 4060.
 9. Hardness: 75-80, Shore D according to ASTM D 2240.
 10. Flame Spread / NFPA 101: Class A according to ASTM E 84.
 11. Coefficient of Friction: Orange peel = 0.8 per ASTM D 2047.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Notify the Architect in writing prior to commencing work of any conditions deemed unsatisfactory for the installation. Installation of flooring materials is considered acceptance of the substrate(s) as satisfactory.
- C. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Effectively remove concrete laitance by steel shot-blasting or other method approved by flooring manufacturer. Surface profile must be a minimum CSP-3 profile according to International Concrete Repair Institute, Guideline #03732. Flooring contractor shall document surface profile using ASTM D-7682 test method.
 - b. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - c. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
 - b. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement. For test results indicating excessive levels of moisture content or vapor emission rate, apply manufacturer's recommended moisture vapor emission control system based on the highest test reading.
 - 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- D. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- E. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Waterproofing Membrane: Apply waterproofing membrane over entire substrate surface, in manufacturer's recommended thickness.
1. Apply waterproofing membrane to integral cove base substrates.
- D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and top-coating of cove base. Round internal and external corners.
1. Integral Cove Base: 6 inches high.
 2. If required, provide cove trim strips at top of base and trowel material up wall to form smooth, integral transition and base.
- E. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.
1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- F. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
- G. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

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- H. Match finish work of approved mockup(s) and uniform in thickness, sheen, color, pattern and texture, and free from defects detrimental to appearance.

3.3 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 099000 – PAINTING AND COATING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. Provide all plant, labor, materials, accessories, equipment and incidentals required to complete Painting and Coating work, including but not necessarily limited to, the following:
 - 1. Surface preparation, priming and finish painting and coating of surfaces, except as otherwise specified.
 - 2. Finish painting and coating primed surfaces, except as otherwise indicated.
 - 3. Exposed to view surfaces unless otherwise indicated, are to be painted and are included in the work of this section.
 - 4. Do not paint prefinished items, conceal surfaces, finished metal surfaces, operating parts and labels.
 - 5. Where touch-up painting and coating work is required, re-finish the entire surface plane.
 - 6. All other surfaces, not specifically noted, that require painting or coatings.

1.3 REFERENCES

- A. SSPC (The Society for Protective Coating) – Steel Structures Painting Manual
- B. EPA (Environmental Protection Agency) Method 24
- C. UL (Underwriters' Laboratories)
- D. ASTM E 84 – Test method for Surface Burning Characteristics of Building Materials
- E. OTC (Ozone Transport Commission)
- F. Applicable state requirement for VOC (Volatile Organic Compounds)

1.4 DEFINITIONS

- A. Sheen: Specular gloss readings in accordance with ASTM D52
 - 1. Flat less than 5 (measured at 85 degrees)
 - 2. Eggshell 5-20 (measured at 60 degrees)
 - 3. Satin 15-35 (measured at 60 degrees)

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4.	Low Luster	25-35	(measured at 60 degrees)
5.	Semi-Gloss	30-65	(measured at 60 degrees)
6.	Gloss	65 or more	(measured at 60 degrees)

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive product data for each paint and coating product finish system specified. Include block fillers and primers. Product data shall include the product name and number, product descriptive performance data, (generic classification or binder type), manufacturer's stock number and date of manufacture, contents by volume for pigment and vehicle constituents, thinning, mixing, application and curing instructions, color name and number, and VOC content. Submit manufacturer's printed application instructions and methods, including mixing, surface preparation, compatible primers and topcoats, recommended wet and dry film thickness.
- B. Colors and Samples: Colors shall be selected by the Architect. The Architect will furnish the Painting subcontractor a schedule of colors and locations of various colors.

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has complete painting and coating system applications similar in material and extent to that indicated for this Project with a record of successful in service performance.
- B. Source limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Material application shall be applied under adequate illumination, evenly spread and smoothly applied, free of runs, sags, holidays, lap marks, air bubbles, and pin holes to assure a smooth finish.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in original unbroken sealed containers with manufacturer's labels intact and in strict accordance with manufacturer's written recommendations. Each container shall be inspected and approved prior to being opened for use. Maintain containers in clean condition, free of foreign materials and residue.
- B. Take every precaution against fire. Store materials in tightly covered containers, in a well ventilated locked area with ambient temperatures continuously maintained at not less than 45 deg. F and in accordance with manufacturer's written requirements. Keep rags, waste, debris, and materials which may constitute fire hazard in water-filled closed, tightly covered, properly labeled, metal containers for daily removal. If tarpaulins are used, they shall be kept neat and no smoking shall be permitted within the space. Provide and maintain proper Class C hand fire extinguishers in the immediate area and all personnel shall be instructed in their use and informed of their location.

- C. Take every precaution against the hazards of fume inhalation. Keep all areas well ventilated at all times. Where natural ventilation is insufficient to provide suitable conditions, provide special fans. If necessary, provide suitable face masks for mechanics.

1.8 PROJECT CONDITIONS

- A. Apply paints and coatings only when temperature of surfaces to be painted or coated and surrounding air temperatures is above 50 and below 90 deg F, unless otherwise permitted by and in accordance with manufacturer's printed instructions.
- B. Do not apply paint and coatings in snow, rain, fog, mist, or when relative humidity exceeds 70 percent and the surface temperature is at least 5 deg, F above the dew point. Prevent wide variation of temperature that might result in condensation on freshly coated surfaces.
- C. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 50 deg. F for 24 hours before, during and 48 hours after application of finishes.
- D. Painting and coating work may be continued during inclement weather if areas and surfaces to be finished are enclosed and heated within temperature and ambient limits specified by the manufacturer during application and drying periods.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional (2) percent, but not less than 1 gallon of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S QUALITY

- A. Materials shall be the highest quality grade (first line architectural), products of their respective kinds. Primers, stains and finishes of each coating system shall be of the same manufacturer.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following, or approved equal.
 - 1. Benjamin Moore (Basis-of-Design)
 - 2. MAB Paints
 - 3. PPG Paints

4. Or Approved Equal.

- C. Coatings for each system shall be the product of the same manufacturer to ensure compatibility of systems. Substitutions of equivalent products of other manufacturers may be submitted for approval providing the products submitted are of the same types, have label analyses similar to those specified, meet or exceed the performance criteria, and are suitable for the use intended as approved by the Architect.
- D. Use thinning materials only as specified by manufacturer's labeled directions for each type of paint and coating. All coatings shall conform to all Federal, State and Local Regulations including VOC rules and air quality standards in effect at the Project location at the time of application.

2.2 MATERIALS GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint, coating, finishing system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint, coating and finishing system, provide products recommended in writing by manufacturers of topcoat for use in paint, coating and finishing system and on substrate indicated.
- B. Colors: As indicated on drawings, or if not indicated, as selected by the Architect from manufacturers full range.

2.3 PAINTING AND COATING SCHEDULE

- A. The following is a general guide for the finish painting required, but does not include every surface or material to be finished or painted. Paint schedule is based on each Manufacturer's first line quality products.
- B. Each of various undercoats of paint other than natural finishes to be a slightly different shade from the preceding coat stepping up to color selected in order to verify number of coats applied.

2.4 EXTERIOR PAINT AND COATING SCHEDULE

- A. Exterior Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer. Touch up fabricator primer and spot coat.
 - 1. Semi Gloss Finish/Latex exposed metal surfaces for average use locations:
 - a. Prime Coat: 1 coat

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- 1) Moore: Moorcraft Super Spec Alkyd Metal Primer (Z06).
 - 2) MAB: Rustolastic Anti-Corrosive Primer (073 line).
 - 3) PPG: Speedhide Alkyd Metal Primer 6-208.
 - b. Finish Coats: 2 coats
 - 1) Moore: Moorcraft SuperSpec DTM Latex Semi Gloss (Z24).
 - 2) MAB: Rustolastic Latex Finish Coating (063 line).
 - 3) PPG: Latex Gloss Industrial Enamel 7-282 Series.
- B. Galvanized Ferrous Metal: Provide the following finish systems over galvanized ferrous metal:
 1. Semigloss, Acrylic Finish: Two finish coats over a primer.
 - a. Primer: As recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer.
 - 1) Moore: Acrylic Metal Primer #M04.
 - 2) MAB: Rustolastic Hydroprime Primer (073-189 line).
 - 3) PPG: Pitt Tech DTM Acrylic Metal Primer 90-712.
 - b. 2 Finish Coats: Semigloss, at spreading rate recommended by the manufacturer.
 - 1) Moore: DTM Acrylic SemiGloss #M29.
 - 2) MAB: Rust-O-Lastic Acrylic DTM (063 line).
 - 3) PPG: Pitt Tech DTM Acrylic Satin Enamel 90-474 Series.
- C. Exterior Application to Exterior Surfaces: Low Luster/Latex:
 1. Prime Coat: 1 coat
 - a. Moore: Fresh Start 100% Acrylic Primer (023).
 - b. MAB: Sea Shore Acrylic Primer (056-958).
 - c. PPG: Speedhide Exterior Acrylic Primer 6-609.
 2. Finish Coats: 2 coats
 - a. Moore: Moorgard Low Luster Latex House Paint (103).
 - b. MAB: Sea Shore Satin House Paint (060 line).
 - c. PPG: Speedhide Exterior Satin Acrylic House Paint 6-2045 Series.

2.5 INTERIOR PAINT AND COATING SCHEDULE

- A. Interior Ferrous Metal: Provide the following finish systems over ferrous metal: For use at higher abuse areas.
 1. Semigloss, Latex Finish: Two finish coats over a primer.

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- a. Primer: Quick-drying, rust-inhibitive, metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer.
 - 1) Moore: IronClad Latex Low Lustre Metal & Wood Enamel, (#363) VOC 380 g/L.
 - 2) MAB: Rust-O-Lastic Hydro Prime, (073 line), VOC 100 g/L.
 - 3) PPG: Pitt-Tech DTM Industrial Enamel, Acrylic Primer 90-712, VOC 123 g/L.
- b. Finish Coats: Semi-Gloss, latex, applied at spreading rate recommended by the manufacturer.
 - 1) Moore:Eco Spec Interior Latex Semi-Gloss Enamel, (#224), VOC 11 g/L.
 - 2) MAB: EnviroPure Latex Semi-Gloss, (047 line), VOC 0g/L.
 - 3) PPG: Pure Performance Semi-Gloss Latex, 9-500 Series, VOC 0 g/L.

B. Interior Non-Ferrous Metal, Galvanized and Aluminum:

- 1. Semigloss, Latex Finish: Two finish coats over a primer.
 - a. Primer: As recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer.
 - 1) Moore: IronClad Latex Low Lustre Metal & Wood Enamel, (#363) VOC 380 g/L.
 - 2) MAB: Rust-O-Lastic Hydro Prime, (073 line), VOC 100 g/L.
 - 3) PPG: Pitt-Tech DTM Industrial Enamel, Acrylic Primer 90-712, VOC 123 g/L.
 - b. Finish Coats: Semi-Gloss, latex, at spreading rate recommended by the manufacturer.
 - 1) Moore: Eco Spec Interior Latex Semi-Gloss Enamel, (#224), VOC 11 g/L.
 - 2) MAB: EnviroPure Latex Semi-Gloss, (047 line), VOC 0g/L.
 - 3) PPG: Pure Performance Semi-Gloss Latex, 9-500 Series, VOC 0 g/L.

C. Interior Plaster and Drywall: (Subject to moisture) toilet areas, etc. SemiGloss Latex Finish.

- 1. Semi-Gloss, Latex Finish: Two finish coats over a primer.
 - a. Prime Coat: 1 coat New wall surfaces:
 - 1) Moore: Rich Lux Latex Sealer Undercoater (037-154), VOC 70 g/L.
 - 2) MAB: EnviroPure Latex Primer, (037-195), VOC 12 g/L.
 - 3) PPG: Pure Performance, Interior Latex Primer, Series 9-900, VOC 0 g/L.
 - b. First and Second Coats: Semi-Gloss, applied at spreading rate recommended by the manufacturer

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- 1) Moore: EcoSpec Interior Latex Eggshell Enamel (224), VOC 11 g/L.
- 2) MAB: EnviroPure Latex Semi-Gloss, (047 line), VOC 12 g/L.
- 3) PPG: Pure Performance, Interior Semi-Gloss Latex, 9-500 Series, VOC 0 g/L.

D. Miscellaneous Items:

1. Concrete Floor Sealer: Concrete floors where sealer is indicated. Acrylic Concrete Sealer:
 - a. Clear Finish:
 - 1) (2) Coats – SealKrete Concrete Floor Sealer (by MAB), or approved equal,
2. Items not specifically detailed or mentioned in specifications but necessary to be painted for proper completion of job, shall be painted in accordance with instructions from Architect.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Applicator shall examine areas and conditions under which painting work is applied and take moisture readings with a reliable electronic moisture meter in sufficient area in each space and as often as necessary to determine the proper moisture content for application and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Applicator and in accordance with paint manufacturer's written requirements for surface preparation. Starting of painting work will be construed as Applicator's acceptance of such faces and conditions within any particular area.

3.2 SURFACE PREPARATION

- A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's written instructions and recommendations and as herein specified, for each particular substrate condition.
- B. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations.
- C. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed item.

- D. Contractor shall prepare all surfaces, walls, ceilings, metal frames, etc., which are to be painted, including but not limited to, scraping, sanding, spackling, patching etc. as necessary to remove loose particles, paint, mildew, greasy residue, splatters, burrs, graffiti, surface decals, surface applied texture materials, mastic, glue, etc. Repoint and/or spackle holes, voids, defects, etc. to form a smooth level surface. Remove nails, screws, anchors and the like. Sand existing metal frames, etc. to smooth out edges of various paint layers.
- E. Clean surfaces to be painted before applying paint or surface treatments. Remove dirt, oil and grease using oil and grease emulsifier such as Moore's M83, or approved equal in accordance with SSPC-SPI Method B2 prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.
- F. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated of oil, grease, dirt loose mill scale and other foreign substances by solvent or mechanical cleaning (SSPC – SP-1).
- G. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum base solvent and artificial abrasive pad.

3.3 MATERIALS PREPARATION

- A. Mix and prepare painting materials in accordance with manufacturer's directions.
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.
- C. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and if necessary, strain material before using.

3.4 APPLICATION

- A. General: Apply paint in accordance with manufacturer's written instructions and recommendations. Use applicators and techniques best suited for substrate and type of material being applied. Apply according to recommended dry film thickness and recommended square foot per gallon.
- B. Apply materials under adequate illumination, evenly spread and smoothly applied, free of runs, sags, holidays, lap marks, air bubbles, and pin holes to assure a smooth finish.
- C. Apply additional coats when undercoat, stains or other conditions show through final paint coat, until paint film is of uniform finish, color and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces. Deep color base primers are to be used under deep finish colors to achieve proper color appearance.

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- D. Sand lightly all abrasions and damaged spots, between each succeeding enamel, varnish coat, textured paint coat, and de-gloss previous painted surfaces if necessary. Spot prime water soluble stains. Re-prime prior to applying finish coats as required.
- E. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
- F. Allow sufficient time between successive coatings to permit proper drying. 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 of paint does not cause lifting or loss of adhesion of the under coat.
- G. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.
- H. Prime Coats: Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others. Prime coats shall be of the same manufacturer as the top coat.
- I. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finished: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.
- K. Guarantee: Manufacturer shall warrant material to conform to specification and be free of manufacturing defects for a period of one year. Applicator will guarantee that its installation of materials conforms to manufacturer's recommendations shall further guarantee its workmanship connected with the installation for a period of one year from the date of installation.
- L. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.
- M. Touch-up work: Touch-up work shall be the responsibility of the Painting Subcontractor.

3.5 CLEAN-UP AND PROTECTION

- A. Clean-up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.
- B. Upon completion of painting work, clean window glass, plumbing fixtures, etc., and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

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- C. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting as acceptable to Architect.
- D. Provide '*Wet Paint*' signs as required to protect newly painted finishes. Remove temporary protective wrappings provided for protection of their work, after completion of painting operations.
- E. At completion of work of other trades, Painting Subcontractor shall touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION 099000

SECTION 101423 – PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. Provide all labor, materials, accessories, equipment and incidentals to provide signs and plaques as indicated including, but not limited to, the following:
 - 1. Interior Permanent Panel Plaques.
 - 2. Exterior Truss Construction Identification Emblem.
- B. Provide identification plaque at each door opening to each space and as indicated on the drawings.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature, specifications and installation instruction for each type of sign required.
- B. Shop Drawings: Submit shop drawings for fabrication and erection of specialty signs. Include plans, elevations, dimensions, large-scale details, sign locations, field measurements, wording, lettering, artwork, and braille layout. Show attachment to other work, field dimensions and accessory items. Furnish location template drawings for items supported or anchored to permanent construction. Obtain Owner's or Architect's written approval of sign text prior to fabrication of signs.
- C. Samples: Submit samples of each color and finish of exposed materials and accessories required for specialty signs. Architect's review of samples will be for color and texture only. When requested, furnish full-size samples of specialty signs materials.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Provide raised image tactile signs in compliance with code provisions of ICC/ANSI A117.1 and The Americans with Disabilities Act (ADA).
- B. Provide Identifying Emblems in compliance with N.J.A.C. 5:23-3.5(e) to identify the building as having floor, roof or both roof and floor trusses.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Panel Signs: Subject to compliance with requirements, manufacturers of panel signs that may be incorporated in the work include, but are not limited to, Best Sign Systems, Inc., (Basis-of-Design) or approved equal.

2.2 PLAQUES

- A. Materials: Plastic room plaques shall be a durable, two color, scratch resistant, non-static, fire retardant, washable melamine surface laminate with non-glare surface and tough colored phenolic core painted a contrasting color after artwork has been carved into the surface and providing raised lettering and braille. Subject to compliance with requirements, manufacturers of products that may be incorporated in the work include, but are not limited to, Best Sign Systems, Inc. Series HC300 Series Plastic Type, Non-Combustible or self-extinguishing type (Basis-of-Design) or approved equal.

1. Material thickness: 1/4 inch.
2. Weight: 2 lbs./sq. ft.
3. Flexural strength flat: 25,000 p.s.i.
4. Tensile strength: 22,000 p.s.i.
5. Compressive strength flat: 47,000 p.s.i.
6. Shear strength: 16,800 p.s.i.
7. Dielectric strength short time (D229 Test): 330 volts/Mil
8. NEMA Rated "self-extinguishing".
9. Bull nose edge condition.
10. 1/2 inch radius corners.

- B. Requirements of All Permanent Room Plaques shall comply with the following provisions for compliance with ICC/ANSI A117.1 and ADA:

1. Characters shall be raised 1/32 inch.
2. Characters shall be upper case and sans serif or "simple serif" type style, as selected by the Architect.
3. Characters shall be accompanied by Grade 2 Braille.
4. Raised characters shall be a minimum of 5/8 inch and a maximum 2 inch high with a width-to-height ratio of between 3:5 and 1:1, stroke width-to-height ratio of between 1:5 and 1:10 (based on upper case X).
5. Equivalent written description (if any) shall be placed directly below pictogram (symbol).
6. Pictograms shall be of sizes indicated on drawings or, if not indicated, with a minimum field of 6 inches in height. Provide pictograms at Accessible Toilet room doors, accessible toilet stalls, accessible entrances, directional signage, stair/elevator instructional signage, etc. as indicated and as required for code compliance.
7. Pictograms shall be raised 1/32 inches, block Type with sharply defined edges, with at least one quarter inch stroke width (if incised).
8. Characters and background shall be eggshell, matte or other non-glare finish.

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9. Characters shall contrast with background (either light on dark or dark on light).
10. Signs shall be located on the wall adjacent to the latch side of the door. (If wall space is inadequate or at double leaf doors, mount signs at nearest adjacent wall).
11. Mount using manufacturer's concealed theft resistant fasteners or other method acceptable to the Architect.
12. Mount sign so that a person can approach within 3" and avoid door swing and protruding objects.
13. Mounting height: Characters shall be 48 inches minimum and 60 inches maximum above adjacent finish floor or ground surface, measured from the base line of the characters.

C. Additional Requirements of All Directional and Informational Plaques shall comply with the following provisions:

1. Characters shall have a width to height ratio of between 3:5 and 1:1.
2. Characters shall have a stroke width to height ratio of between 1:5 and 1:10.
3. Characters shall be sized according to the viewing distance from which they are to be read.
4. Lower case characters are permitted.
5. Characters and background shall be eggshell, matte or other non-glare finish.
6. Characters shall contrast with background (either light on dark or dark on light).
7. Pictograms shall be of sizes indicated on drawings or, if not indicated, with a minimum field of 6 inches in height. Provide pictograms at Non-accessible toilet room doors, non-accessible entrances, non-accessible stairs, etc. as indicated and as required for code compliance.

D. Panel Sign Types:

1. Room Plaques shall be of types and sizes indicated or, if not indicated, shall be 8" x 6" in size and contain the room name in lettering and Braille, unless noted otherwise.
 - a. Provide identification plaque at each entrance to each space shown on the room finish schedule and as indicated elsewhere on the drawings.
2. Accessible Toilet Room Plaques: Shall be 6" x 8" containing the International Symbol of Accessibility together with gender pictogram and name as follows:
 - a. Provide one sign at the outside of each entrance to accessible toilet rooms.
3. Accessible Toilet Stall Plaques: Shall be 6" x 6" containing the International Symbol of Accessibility.
 - a. Provide one sign at the outside of each entrance to Accessible Stalls.

2.3 EXTERIOR TRUSS CONSTRUCTION IDENTIFICATION EMBLEM

A. Identifying Emblem shall be made of 18 gauge bonderized steel. Emblem shall be of a bright and reflective color. Shape of the emblem shall be an isosceles triangle and the size shall be 12 inches horizontally by 6 inches vertically. The following letters, of a size and color to make them conspicuous, shall be printed on the emblem:

1. "F" to signify a floor with truss construction;
2. "R" to signify a roof with truss construction; or
3. "F/R" to signify both a floor and roof with truss construction.

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. Verify that items including anchor inserts provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sign units and components at locations shown or scheduled, securely mounted with concealed theft-resistant fasteners, unless otherwise indicated. Attach signs to substrates in accordance with manufacturer's instructions.
- B. Install level, plumb, and at proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace units as directed by Architect.
- C. Location of room and capacity plaques to be mounted with characters 48 inches minimum and 60 inches maximum above the adjacent finished floor or ground surface measured from the baseline of the characters on wall next to door on the latch side when door is closed. When a tactile sign is provided at double doors, the sign shall be to the right of the right hand door. Where there is no space on the latch side of a single door, or the right side of double doors, signs shall be on the nearest adjacent wall. Signs containing tactile characters shall have an 18 inch minimum by 18 inch minimum space on the floor or ground centered on the sign, beyond the arc of any door swing between the closed position and 45 degree open position.
 - 1. Exception: Door mounted signs shall be permitted on the push side of the doors without closers and without hold-open devices.
- D. Apply plaques in strict compliance with the manufacturer's printed recommendations. Clean all surfaces exposed to view before final completion.
- E. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:
 - 1. 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.

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.

END OF SECTION 101423

SECTION 102113 - STAINLESS-STEEL TOILET COMPARTMENTS

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 stainless-steel toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for blocking and support of floor and ceiling anchored compartments and screens.
 - 2. Section 102800 "Toilet Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings: For toilet compartments.
 - 1. Include plans, elevations, sections, details, and attachment details.
 - 2. Show locations of cutouts for compartment-mounted toilet accessories.
 - 3. Show locations of reinforcements for compartment-mounted grab bars and locations of blocking for surface-mounted toilet accessories.
 - 4. Show locations of centerlines of toilet fixtures.
 - 5. Show locations of floor drains.
- C. Samples: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.

- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.
- E. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with applicable provisions of ICC/ANSI-A117.1 and the Americans with Disabilities Act for toilet compartments designated as accessible.

2.2 STAINLESS-STEEL TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, manufacturers of products that may be acceptable for inclusion in the work include, but are not limited to, the following:
 - 1. Hadrian Manufacturing Inc. (Basis-of-Design)
 - 2. Bradley Corporation.
 - 3. Global Partitions, an ASI Group Company.
- B. Toilet-Enclosure Style: Floor anchored overhead braced.
- C. Urinal-Screen Style: Wall hung flat panel wall hung with post.
- D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
 - 1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.
 - 2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand applied downward load on grab bar of at least 250 lbf, when tested according to ASTM F 446, without deformation of panel.

3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

E. Urinal-Screen Construction:

1. Flat-Panel Urinal Screen: Matching panel construction.
2. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches thick.

F. Facing Sheets and Closures: Stainless-steel sheet of nominal thicknesses as follows:

1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.038 inch.
2. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.050 inch.
3. Panels: Manufacturer's standard thickness, but not less than 0.031 inch.
4. Doors: Manufacturer's standard thickness, but not less than 0.031 inch.
5. Flat-Panel Urinal Screens: Thickness matching the panels.
6. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.031 inch.

G. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

H. Urinal-Screen Post: Manufacturer's standard post design of [material matching the thickness and construction of pilasters; with shoe and sleeve (cap) matching that on the pilaster.

I. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

J. Stainless-Steel Finish: No. 4 bright, directional polish on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch thick stainless steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door. Mount with through-bolts.
2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.

3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors and entrance-screen doors. Mount with through-bolts.
 5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip 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 anchors compatible with related materials.

2.4 MATERIALS

- A. Aluminum Castings: ASTM B 26.
- B. Aluminum Extrusions: ASTM B 221.
- C. Brass Castings: ASTM B 584.
- D. Brass Extrusions: ASTM B 455.
- E. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- F. Stainless-Steel Castings: ASTM A 743.
- G. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories and solid blocking within panel where required for attachment of toilet accessories.
- B. 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.
- C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

- D. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.
- E. Door Size and Swings: Unless otherwise indicated, provide 24-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 areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. 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.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb,

and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

- D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

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 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to fully closed position.

END OF SECTION 102113

SECTION 102800 - TOILET ACCESSORIES

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 DESCRIPTION OF WORK

- A. Extent of each type of toilet accessory as shown on drawings and scheduled herein.
- B. All operating devices to comply with ADA and to ICC/ANSI A117.1 requirements for mounting heights and operating force.

1.3 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. 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.
- C. Warranty: Sample of special warranty.
- D. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from single source from single manufacturer.
- B. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

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- C. Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units.
- D. 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.
- E. Manufacturer: Provide each type of toilet accessory required by a single manufacturer as manufactured by Bobrick Washroom Equipment, Inc. or approved equal.

1.5 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153, 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 ACCESSORY SCHEDULE

- A. A 'TOILET ACCESSORY SCHEDULE' is included within the Architectural Drawings as an extension of this Specification Section.

2.3 UNDERLAVATORY GUARDS

- A. Basis-of-Design Product: LavGuard by Truebro, Inc., or approved equal.
- B. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
- C. Material and Finish: Antimicrobial, molded plastic, white.

2.4 BABY CHANGING STATION

- A. Basis-of-Design Product: KB200-SS by Koala Kare Products, or approved equal.
- B. Description: Horizontal wall mounted baby changing station with stainless steel finish veneer. Unit shall equipped with a pneumatic cylinder for control opening and closing of bed. Bed shall be secured to metal mounting chassis with concealed steel-on-steel hinge.
- C. Material and Finish: Antimicrobial embedded injection-molded polypropylene, Grey.

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 (6) 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.

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- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for 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 type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

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- g. Bare Piping in Equipment Rooms: One-piece, cast-brass type 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 type.
- 3.2 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron swing check valves with closure control.
7. Bronze gate valves.
8. Iron gate valves.
9. Bronze globe valves.
10. Iron globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

- ##### A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- ##### B. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- ##### A. Refer to valve schedule articles for applications of valves.
- ##### B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

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. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.4 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

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. Crane Co.; Crane Valve Group; Jenkins Valves.
 - b. NIBCO INC.
 - c. Powell Valves.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.5 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

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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. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and spring.

2.6 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Powell Valves.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.

- c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

2.7 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

- 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. Milwaukee Valve Company.
 - b. NIBCO INC
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Throttling Service: Globe or ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 125, bronze disc.
 - 3. Ball Valves: Two piece, full port, brass with brass trim.
 - 4. Bronze Swing Check Valves: Class 125, bronze disc.
 - 5. Bronze Gate Valves: Class 125, NRS.
 - 6. Bronze Globe Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
 - 3. Iron Swing Check Valves: Class 125, metal seats.
 - 4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
 - 5. Iron Gate Valves: Class 125, NRS.
 - 6. Iron Globe Valves: Class 125.

3.5 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One piece, full port, brass with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, metal seats.
3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
4. Iron Gate Valves: Class 125, NRS.
5. Iron Globe Valves: Class 125.

END OF SECTION 220523

SECTION 220524 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

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 B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. 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. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

H. 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 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves with Full Port, and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-110.
 - 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.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.2 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 is indicated in valve schedules below.

2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.3 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, brass ball valve.
3. One piece, bronze ball valve with bronze trim.
4. Two-piece, bronze ball valves with full port and bronze or brass trim.

END OF SECTION 220524

SECTION 220525 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze swing check valves.
2. Iron swing check valves.
3. Iron swing check valves with closure control.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

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 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. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts; a Watts Water Technologies company.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts; a Watts Water Technologies company.
2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: PTFE.

2.3 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.

- c. Watts; a Watts Water Technologies company.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged or threaded. See valve schedule articles.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane; Crane Energy Flow Solutions.
- b. Stockham; Crane Energy Flow Solutions.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged or threaded. See valve schedule articles.
- f. Trim: Composition.
- g. Seat Ring: Bronze.
- h. Disc Holder: Bronze.
- i. Disc: PTFE.
- j. Gasket: Asbestos free.

2.4 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

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

- a. NIBCO INC.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.

- e. Ends: Flanged or threaded. See valve schedule articles.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.
- h. Closure Control: Factory-installed exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever and Weight-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Watts; a Watts Water Technologies company.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged or threaded. See valve schedule articles.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed exterior lever and weight.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; metal-seat or resilient-seat check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified 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.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
 - 3. For Copper Tubing, NPS 5 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 5 and Larger: Flanged.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze swing check valves, Class 125, bronze disc with soldered or threaded end connections.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron swing check valves, Class 125, metal seats with threaded or flanged end connections.
 - 2. Iron swing check valves with closure control, Class 125, lever and spring with threaded or flanged end connections.

END OF SECTION 220525

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 ACTION 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. Equipment supports.

- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

- B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

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9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 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.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Blue.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch Insert dimension thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering

for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 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: Size letters according to ASME A13.1 for piping.

PART 3 - EXECUTION

3.1 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.2 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

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1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Domestic Water Piping
 - a. Background: Safety green.
 - b. Letter Colors: White.
2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Safety white.
 - b. Letter Color: Black.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold and hot-water piping.
 - 2. Domestic recirculating hot-water piping.
 - 3. Sanitary waste piping exposed to freezing conditions.
 - 4. Storm-water piping exposed to freezing conditions.
 - 5. Roof drains and rainwater leaders.
 - 6. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. 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.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor 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 in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Pittsburgh Corning Corporation.
 - 2. Special-Shaped Insulation: ASTM C 552, Type III.
 - 3. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 - 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- E. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Manson Insulation Inc.

c. Owens Corning.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 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. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 3. Solids Content: 60 percent by volume and 66 percent by weight.
 4. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 016000 "Product Requirements."

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.

2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.

2.10 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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. 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.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at 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.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. 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.
- E. 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."
- 3.4 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 MINERAL-FIBER PREFORMED PIPE 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 straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 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.

3.7 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. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 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. Domestic Cold, Hot and Recirculated Hot Water: Insulation shall be one of the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 2. Cold Water: 1 inch thick.
 - 3. Hot Water and Hot Water Return: 1 inch thick (1/2" – 1 1/4" Pipe Sizes) 1 1/2 inch thick (1 1/2" to 4" Pipe sizes)
- B. Stormwater and Overflow: Insulation shall be one of the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Roof Drain and Overflow Drain Bodies: Insulation shall be one of the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be one of the following:
 - 1. Polyolefin: 1/2 inch thick.
- E. Sanitary Waste Piping Where Heat Tracing Is Installed: Mineral-fiber, preformed pipe insulation, Type I, 1-1/2 inches thick.

3.10 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.

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C. Piping, Concealed:

1. None.
2. PVC: 20 mils thick.

D. Piping, Exposed:

1. None.
2. PVC: 20 mils thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
- 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.

1.2 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.3 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61 and NSF 372. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. 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.

F. Copper Pressure-Seal-Joint Fittings:

1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

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 B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 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.

2.6 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.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.

- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- S. Install thermostats in hot-water circulation piping.
- T. 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."
- U. 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."
- V. 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."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- 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 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.

- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
 - E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
 - F. Install supports for vertical copper tubing every 10 feet.
 - G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
 - H. Install supports for vertical steel piping every 15 feet.
 - I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- 3.7 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.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 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. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 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 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. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
 - C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- 3.12 PIPING SCHEDULE
- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
 - C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
 - D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
 - E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

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2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.
4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Strainers.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
9. Water-hammer arresters.
10. Trap-seal primer valves.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 372.

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 Breakers:

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: 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.

2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. 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.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

- 1. Standard: ASSE 1003.
- 2. Pressure Rating: Initial working pressure of 150 psig.
- 3. Design Flow Rate: 125.
- 4. Design Inlet Pressure: 85.
- 5. Design Outlet Pressure Setting: 65.
- 6. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron for NPS 2-1/2 and NPS 3.
- 7. Valves for Booster Heater Water Supply: Include integral bypass.
- 8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. 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.
- 7. Seats and Seals: Replaceable.
- 8. End Connections: Solder joint or threaded.
- 9. Handle: Vinyl-covered steel with memory-setting device.

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 4: 0.045 inch.
6. Drain: Pipe plug.

2.8 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 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: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Standard: ASME A112.21.3M for concealed-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 or NPS 1.
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: Polished nickel bronze.
9. Operating Keys(s): Two with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:

1. Standard: ASSE 1019, Type A or Type B.
2. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
3. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
4. Pressure Rating: 125 psig.
5. Operation: Loose key or wheel handle.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 1/2 or NPS 3/4.
8. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.10 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.

2.11 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters <Insert drawing designation if any>:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.12 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
2. Size: NPS 1-1/4 minimum.

3. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve.
- E. Install water-hammer arresters in water piping according to PDI-WH 201.
- F. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Test each pressure vacuum breaker and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

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.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
- C.
 - 1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
- D. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 2. Copper DWV tube, copper drainage fittings, and soldered joints.
- D. Aboveground, soil, waste, and vent piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
- E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
- F. Underground, soil and waste Piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.

3.2 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

- E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 VALVE INSTALLATION

- A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Use gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Use gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valves are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

4. NPS 6: 60 inches with 3/4-inch rod.
 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
- I. Install supports for vertical copper tubing every 10 feet.

3.6 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

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- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
 - 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 2. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Flashing materials.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:

1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron 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. Closure: Brass plug with straight threads and gasket.
6. Adjustable Housing Material: Cast iron with set-screws or other device.
7. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
8. Frame and Cover Shape: Round.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
5. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
6. Wall Access: Round, wall-installation frame and cover.

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. Anchor Flange: Not required.
5. Outlet: Bottom type.
6. Sediment Bucket: Not required.
7. Top Shape: Round.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. 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.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. 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.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

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.

2.5 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.

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- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- 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 flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

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. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Faucets for lavatories and sinks.
 - 2. Flushometers.
 - 3. Toilet seats.
 - 4. Protective shielding guards.
 - 5. Fixture supports.
 - 6. Water closets.
 - 7. Urinals.
 - 8. Lavatories.
 - 9. Kitchen sinks.
 - 10. Service sinks.

1.2 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.

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- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. LEAD FREE REQUIREMENT: Products designed for dispensing potable water shall meet NSF 61 and NSF 372 test standards via third-party testing and certification.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Plastic Sinks: ANSI Z124.6.
 - 2. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 3. Vitreous-China Fixtures: ASME A112.19.2M.
 - 4. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 5. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 6. Stainless Steel Fixtures: ASTM A480/A480M, No. 4 polished finish on exposed surfaces.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Potable-Water Materials: NSF 61.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 11. Supply Fittings: ASME A112.18.1.
 - 12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Manual-Operation Flushometers: ASSE 1037.
 - 4. Brass Waste Fittings: ASME A112.18.2.
 - 5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Flexible Water Connectors: ASME A112.18.6.
 - 2. Grab Bars: ASTM F 446.
 - 3. Hose-Coupling Threads: ASME B1.20.7.

4. Hot-Water Dispensers: ASSE 1023 and UL 499.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Toilet Seats: ANSI Z124.5.
8. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

- A. Lavatory Faucets, (Refer to Plumbing Fixture Schedule on drawings):
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sloan Valve Company.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Symmons Industries, Inc.

2.2 SINK FAUCETS

- A. Sink Faucets, (Refer to Plumbing Fixture Schedule on drawings):
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard Companies, Inc.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Symmons Industries, Inc.

2.3 FLUSHOMETERS

- A. Flushometers, (Refer to Plumbing Fixture Schedule on drawings):
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sloan Valve Company.
 - b. Zurn Plumbing Products Group; Commercial Brass Operation.
 - c. Delta Faucet Company.
 - d. Hydrotek International, Inc.

2.4 TOILET SEATS

- A. Toilet Seats, (Refer to Plumbing Fixture Schedule on drawings):
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard Companies, Inc.
 - b. Bemis Manufacturing Company.
 - c. Centoco Manufacturing Corp.
 - d. Church Seats.
 - e. Eljer.

2.5 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers, (Refer to Plumbing Fixture Schedule on drawings):
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Engineered Brass Co.
 - b. Plumberex Specialty Products Inc.
 - c. TRUEBRO, Inc.
 - d. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2.6 FIXTURE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- C. Water-Closet Supports:
1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- D. Urinal Supports:

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1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.7 WATER CLOSETS

A. Water Closets, (Refer to Plumbing Fixture Schedule on drawings):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Acorn Engineering Company; a Division of Morris Group International.](#)
 - b. [I-Con Systems, Inc.](#)
 - c. [Willoughby Industries.](#)

2.8 URINALS

A. Urinals, (Refer to Plumbing Fixture Schedule on drawings):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Acorn Engineering Company; a Division of Morris Group International.](#)
 - b. [I-Con Systems, Inc.](#)
 - c. [Willoughby Industries.](#)

2.9 LAVATORIES

A. Lavatories, (Refer to Plumbing Fixture Schedule on drawings):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Acorn Engineering Company; a Division of Morris Group International.](#)
 - b. [I-Con Systems, Inc.](#)
 - c. [Willoughby Industries.](#)

2.10 KITCHEN SINKS

- A. Kitchen Sinks, (Refer to Plumbing Fixture Schedule on drawings):
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dayton Products, Inc.
 - b. Elkay Manufacturing Co.
 - c. Kohler Co.
 - d. Sterling Plumbing Group, Inc.

2.11 SERVICE SINKS

- A. Service Sinks, (Refer to Plumbing Fixture Schedule on drawings):
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard Companies, Inc.
 - b. Commercial Enameling Company.
 - c. Crane Plumbing, L.L.C./Fiat Products.
 - d. Eljer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

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- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install toilet seats on water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- P. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."
- Q. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224713 - DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes drinking fountains and related components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountains.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountains (Refer to Plumbing Fixture Schedule on drawings): Stainless steel, wheelchair accessible, wall mounted.

- 1. Stainless-Steel Drinking Fountains:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Elkay.
- 2) Haws Corporation.
- 3) Oasis International.

- 2. Standards:

- a. Comply with ASME A112.19.3/CSA B45.4.
- b. Comply with NSF 61 and NSF 372.
- c. Comply with ICC A117.1.
- 3. Bubblers: Two, with adjustable stream regulator, located on deck.
- 4. Bottle-Filling Station.
- 5. Maximum Water Flow: 0.15 gpm.
- 6. Control: Push button.
- 7. Drain: Grid type with NPS 1-1/4 tailpiece.
- 8. Supply Piping: NPS 3/8 with shutoff valve.

9. Drain Piping: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
10. Support: Type II water cooler carrier.
11. Drinking Fountain Mounting Height: Standard, Handicapped/elderly according to ICC A117.1.

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 pedestal drinking fountains on floor.
- C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- D. 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."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. 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."
- G. 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."
- H. Adjust fixture flow regulators for proper flow and stream height.

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 CLEANING

- A. After installation, 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 224713

SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. HVAC demolition.
7. Equipment installation requirements common to equipment sections.
8. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

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- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Re-greasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230553 - IDENTIFICATION FOR HVAC 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. Duct labels.
 - 4. 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.

1.4 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:

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1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. 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.
- 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), 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: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 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: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. 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.

2.4 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 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.
- 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 **20 feet** in each space where ducts are exposed or concealed by removable ceiling system.

3.4 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.3 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.

1.4 INFORMATIONAL 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.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.

B. TAB Conference: Meet with Architect on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

- a. The Contract Documents examination report.
- b. The TAB plan.
- c. Coordination and cooperation of trades and subcontractors.
- d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect or Engineer.

1.6 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.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, manual volume dampers, etc. 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 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 filters. Verify that startup filters are replaced by permanent filters of correct size and media.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- 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.

3.2 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. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Isolating and balancing dampers are open / correct position and operational.
 - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

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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 or Engineer 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.

3.6 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.

3.7 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.

3.8 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.

- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.9 TOLERANCES

- A. Set HVAC system's air 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.

3.10 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.

3.11 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. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. 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.

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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 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. Duct, outlet, and inlet sizes.
 3. Terminal units.
 4. Balancing stations.
 5. 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. Heating section static-pressure differential in **inches wg**.
- h. Outdoor airflow in **cfm**.
- i. Return airflow in **cfm**.
- j. Outdoor-air damper position.
- k. Return-air 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. Entering-water temperature in **deg F**.
- i. Leaving-water temperature in **deg F**.

G. 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**.

H. 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**.

I. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.12 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 room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. 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 Architect or Engineer..
- 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect or Engineer..
- 3. Architect or 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.

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- 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.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply
 - 2. Indoor, exposed supply
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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 insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," and "Indoor Duct and Plenum 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 in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, [Type III with factory-applied FSK jacket Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. 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).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, 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 D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.

2. Color: White

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 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 C 1136.
 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.

2.8 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
- B. Insulation Pins and Hangers:
 - 1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: [Copper- or zinc-coated, low-carbon steel] [Aluminum] [Stainless steel], fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
 - 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, [galvanized-steel] [aluminum] [stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

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- a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel, 0.062-inch soft-annealed, galvanized steel.

2.9 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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.

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- 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
 - 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.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Seal jacket to roof flashing with flashing sealant.
- B. 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.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 INSTALLATION OF MINERAL-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.

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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.
- B. Board 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 space 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. 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. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.6 FINISHES

- A. Insulation with ASJ 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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. 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, 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 noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket or board 1-1/2 thick and 0.75-lb/cu. Ft nominal density.
- B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket or board 1-1/2 thick and 0.75-lb/cu. Ft nominal density.
- C. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket or board 1-1/2 thick and 0.75-lb/cu. Ft nominal density.
- D. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket or board 1-1/2 thick and 0.75-lb/cu. Ft nominal density.

3.10 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. Ducts and Plenums, Concealed:
 1. None.
- D. Ducts and Plenums, Exposed:

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1. None.

END OF SECTION 230713

SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sheet metal materials.
6. Sealants and gaskets.
7. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 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" and ASCE/SEI 7.
- 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 product indicated.
- B. Shop Drawings:

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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. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- D. Welding certificates.

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.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 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. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. Sheet Metal Connectors, Inc.

d. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "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.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. McGill AirFlow LLC.
2. Sheet Metal Connectors, Inc.

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 intervals, 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 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.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
- H. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent
- I. 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."
- J. 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."

2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.

e. Spiral Manufacturing Co., Inc.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "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.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.5 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: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. 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. <Insert manufacturer's name>.
 - f. 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. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- 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: 3 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).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, 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).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg 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 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 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.

3.4 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.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.

- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "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.

3.5 DUCT CLEANING

- A. Clean new and existing duct systems 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.

3.6 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.

3.7 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
 1. Ducts Connected to Equipment:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.

B. Return Ducts:

1. Ducts Connected to Equipment:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Louvers and Hoods.
 - a. Pressure Class: Positive or negative 2-inch wg.
 - a. Minimum SMACNA Seal Class: A.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.

F. Liner:

1. Supply Air Ducts: Fibrous glass, Type I 1-1/2 inches thick.
2. Return Air Ducts: Fibrous glass, Type I 1-1/2 inches thick.
3. Exhaust Air Ducts: [Fibrous glass, Type I 1-1/2 inches thick.
4. Supply Fan Plenums: Fibrous glass, Type II 1-1/2 inches thick.
5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II 1-1/2 inches thick.
6. Transfer Ducts: Fibrous glass, Type I 1 inch thick.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm 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.

H. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
- 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm 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 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Manual volume dampers.
 - 3. Control dampers.
 - 4. Fire dampers.
 - 5. Flange connectors.
 - 6. Turning vanes.
 - 7. Duct-mounted access doors.
 - 8. Flexible connectors.
 - 9. Flexible ducts.
 - 10. Duct accessory hardware.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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, including sleeves; and duct-mounted access doors.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. 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.
- C. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. 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.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 1000 fpm.
- D. Maximum System Pressure: 1-inch wg.
- E. Frame: Hat-shaped, 0.05-inch- thick, galvanized sheet steel, with welded corners or mechanically attached.
- F. Blades: Multiple single-piece blades, center pivoted with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Vinyl foam'
- I. Blade Axles:
 - 1. Material: Nonferrous metal.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.

- L. Bearings: Steel ball or 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: Aluminum.
 - 8. Screen Type: Bird.
 - 9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 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. Air Balance Inc.; a division of Mestek, Inc.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Ruskin Company.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel.
 - 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. Oil-impregnated bronze.
 - 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.

2.5 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Greenheck Fan Corporation.
 - 2. McGill AirFlow LLC.

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3. Nailor Industries Inc.
4. Ruskin Company.

B. Frames:

1. Hat shaped.
2. 0.094-inch- thick, galvanized sheet steel.
3. Mitered and welded corners.

C. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Parallel blade design.
3. Galvanized-steel.
4. 0.064 inch thick single skin.
5. Blade Edging: Closed-cell neoprene.

D. Blade Axles: 1/2-inch- diameter; galvanized 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.

E. Bearings:

1. Oil-impregnated bronze
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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.
4. Vent Products Company, Inc.

B. Type: Static; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wgstatic pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.05 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.

- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.024-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- K. Heat-Responsive Device: replaceable link, factory installed, 165 deg F rated.

2.7 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. METALAIRE, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall.

2.9 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. McGill AirFlow LLC.
 - 4. Nailor 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 insulation fill 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: Continuous] and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches[with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.10 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. > or comparable product by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Ventfabrics, Inc.
- C. Materials: Flame-retardant or noncombustible fabrics.
- D. Coatings and Adhesives: Comply with UL 181, Class 1.
- E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two 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.
- F. 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.

- G. 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.

2.11 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
 - 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.
- C. 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; polyethylene 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.
- D. Flexible Duct Connectors:
 - 1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.
 - 2. Non-Clamp Connectors: Adhesive.

2.12 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

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- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream 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. Control devices requiring inspection.
 - 8. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 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.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.

- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with adhesive.
- P. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 237223 - AIR-TO-AIR ENERGY RECOVERY 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. Fixed-plate total heat exchangers.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.
 - 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. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For air-to-air energy recovery equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of air-to-air energy recovery equipment.
 - 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.
 - 3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, elevations, 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 equipment or suspension systems will be attached.
- B. Seismic Qualification Data: Certificates, for air-to-air energy recovery 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.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in 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. Filters: One set(s) of each type of filter specified.
 - 2. Fan Belts: One set(s) of belts for each belt-driven fan in energy recovery units.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ARI Compliance:
 - 1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."
 - 2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."

C. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

E. UL Compliance:

1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."
2. Electric coils shall comply with requirements in UL 1995, "Heating and Cooling Equipment."

1.9 COORDINATION

- A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Packaged Energy Recovery Units: Two years.

PART 2 - PRODUCTS

2.1 FIXED-PLATE TOTAL HEAT EXCHANGERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. RenewAire or equivalent.
- B. Casing: Galvanized steel.

- C. Plates: Evenly spaced and sealed and arranged for counter airflow.
 - 1. Plate Material: Chemically treated paper with selective hydroscopicity and moisture permeability, and gas barrier properties.
- D. Bypass Plenum: Within casing, with gasketed face-and-bypass dampers having operating rods extended outside casing.
- E. Disposable Panel Filters:
 - 1. Comply with NFPA 90A.
 - 2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
 - 3. Factory-fabricated, viscous-coated, flat-panel type.
 - 4. Thickness: 1 inch..
 - 5. Minimum Arrestance: 80, according to ASHRAE 52.1.
 - 6. MERV: 5, according to ASHRAE 52.2.
 - 7. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
 - 8. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

2.2 BLOWER MOTOR

- A. Blower motors shall be direct drive, premium efficiency and totally enclosed fan cooled (TEFC) with factory installed motor starters.
- B. Fan shall be forward curved type.
- C. Unit shall have both supply and exhaust fans with variable speed drive controllers.

2.3 CONTROLS

- A. Unit shall have integral controls with terminal strips, microprocessor controllers and sensors, etc.
- B. Unit shall have variable frequency drives for each fan.
- C. Provide integral outside air and exhaust (and economizer bypass where specified – see drawing schedule) motorized dampers with factory controls.
- D. Equipment Interlock DDC Start/Stop Installations: Solid-state, relay and contacts for microprocessor-based unit, with auto-reset after power failure to energize unit.
- E. Standalone Time Clock Installations: Solid-state, programmable, microprocessor-based unit for wall mounting with up to eight on/off cycles per day and battery backup protection of program settings against power failure to energize unit.

2.4 CAPACITIES AND CHARACTERISTICS

- A. See drawings for equipment capacity criteria.

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. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixed-plate heat exchangers so supply and exhaust airstreams flow in opposite directions.
 - 1. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to heat exchanger. Access doors and panels are specified in Section 233300 "Air Duct Accessories."
- B. Equipment Mounting:
 - 1. Install Retain first paragraph below for suspended units. Retain option for projects in seismic areas.
- C. Roof Mounting Unit Support: Install unit level on structural curbs. Secure air-to-air energy recovery equipment to structural support with anchor bolts.
- D. Floor Mounting Unit Support: Install unit level on 4" high concrete pad. Secure air-to-air energy recovery equipment to pad with anchor bolts.
- E. Ceiling Mounting Unit Support: Install unit level on suspended threaded hanger rods with vibration isolation and supplemental structural supports as required. Secure air-to-air energy recovery equipment to hanger support with fastener bolts. Provide and secure hanger supports to structure above as per structural engineer's recommendations.
- F. Install units with clearances for service and maintenance.

- G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Adjust seals and purge.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 4. Set initial temperature and humidity set points.
 - 5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 237223

SECTION 238216 – ELECTRIC-RESISTANCE AIR COILS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes electric resistance air coils.

1.2 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 air coil.
 - 2. Include rated capacities, operating characteristics, and pressure drops for each air coil.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. RenewAire
 - 2. Qmark
 - 3. Indeeco
- B. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS

- A. Testing Agency Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Coil Assembly: Comply with UL 1995.
- C. Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium-oxide powder in tubular-steel sheath; with spiral-wound, copper-plated, steel fins continuously brazed to sheath.
- D. Heating Elements: Open-coil resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, and fastened to supporting brackets.
- E. High-Temperature Coil Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or casing.
 - 1. Secondary Protection: Load-carrying, manually reset or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
- F. Frames: Galvanized-steel channel frame, minimum 0.064 inch thick for flanged mounting.
- G. Control Panel: Unitmounted with disconnecting means and overcurrent protection. Include the following controls:
 - 1. Magnetic contactor.
 - 2. Mercury contactor.
 - 3. Toggle switches; one per step.
 - 4. Step controller.
 - 5. Time-delay relay.
 - 6. Pilot lights; one per step.
 - 7. Airflow proving switch.
- H. See Section 230923.27 "Temperature Instruments" for thermostat.
- I. Thermostats: Wall-mounted thermostats, with temperature range from 50 to 90 deg F and 2.5 deg F throttling range.
- J. Temperature Sensors: Duct mounted sensors, with temperature range from 50 to 90 deg F.
- K. Capacities and Characteristics:
 - 1. See drawings for performance criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Prepare test and inspection reports.

END OF SECTION 238216

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
2. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2 and 3 control cables.
3. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- ##### A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- ##### A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- ##### B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- ##### C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable,

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 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 NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- D. Coordinate "Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground" Paragraph below with Section 260543 "Underground Ducts and Raceways for Electrical Systems."
- E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- F. Feeders Installed below Raised Flooring: Type THHN-2-THWN-2, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.

- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC Nonmetallic-sheathed cable.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN-2-THWN-2, single conductors in raceway or Metal-clad cable, Type MC.
- K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report to record the following:

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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.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. UTP cabling.
2. RS-485 cabling.
3. Low-voltage control cabling.
4. Control-circuit conductors.
5. Identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

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.

2.2 PERFORMANCE REQUIREMENTS

- A. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- B. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.3 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."
- B. Painting: Paint plywood on all sides and edges with [flat] [eggshell] [black] <Insert color> [latex] [alkyd] paint. Comply with requirements in Section 099123 "Interior Painting."

2.4 UTP CABLE

- A. Description: 100-ohm, four-pair UTP, 24-pair UTP, formed into four-pair binder groups with no overall jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties of Category 5e cables.
 - 2. Comply with ICEA S-102-700 for mechanical properties of Category 6 cables.
 - 3. Comply with TIA-568-C.1 for performance specifications.
 - 4. Comply with TIA-568-C.2, Category 6A.
 - 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with NEMA WC 66, UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP complying with UL 1685. Type CM or Type CMX in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

- b. Communications, Riser Rated: Type CMP, or Type CMR in listed plenum or riser communications raceway. Type CMP or Type CMR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- c. Communications, General Purpose: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed per NFPA 70.

2.5 UTP CABLE HARDWARE

- A. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- B. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
- D. Jacks and Jack Assemblies: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-C.1.
- E. Patch Cords: Factory-made, four-pair cables in 48-inch lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.
- F. Workstation Outlets: Two-port-connector assemblies mounted in single faceplate.
- G. Faceplates:
 - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 - 2. Metal Faceplate: Stainless steel or as specified by the architect complying with requirements in Section 262726 "Wiring Devices."
 - 3. For use with snap-in jacks accommodating any combination of UTP, optical-fiber, and coaxial work area cords.
 - a. Flush-mounted jacks, positioning the cord at a 45-degree angle.

H. Legend:

1. Factory labeled by silk-screening or engraving.
2. Machine printed, in the field, using adhesive-tape label.
3. Snap-in, clear-label covers and machine-printed paper inserts.

2.6 RS-485 CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, one pair, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.7 LOW-VOLTAGE CONTROL CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.8 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 44 UL 83.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 44 UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 44 UL 83.

- D. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

- 1. Smoke control signaling and control circuits.

2.9 SOURCE QUALITY CONTROL

- A. Factory test UTP cables according to TIA-568-C.2.
- B. Factory test optical-fiber cables according to TIA-568-C.3.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
 - 2. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard if entering the room from overhead.
 4. Extend conduits 3 inches above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch dimension horizontally. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1 and NFPA 70.
- B. General Requirements for Cabling:
1. Comply with TIA-568-C Series of standards.
 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems".
 3. Terminate all conductors and optical fibers; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and patch panels.
 4. Cables may not be spliced.
 5. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Install lacing bars and distribution spools.
 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Monitor cable pull tensions.
 10. Support: Do not allow cables to lie on removable ceiling tiles.

11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.

C. UTP Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271500 "Communications Horizontal Cabling" unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified for future use with a tag.

3.5 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

- A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Visually inspect UTP and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters

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that are qualified by test equipment manufacturer for channel or link test configuration.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. ILSCO.
 - 4. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 - 5. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

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 barecopper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout. Contractor shall coordinate with the local utility for final requirements.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits. Contractor shall coordinate with the local utility for final requirements.
- D. Pad-Mounted Transformers and Switches: Install two ground rods around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for taps to equipment grounding terminals.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, 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. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- 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.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- F. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.5 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.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: 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.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 ACTION SUBMITTALS

- A. Product Data: For steel slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze hangers. Include Product Data for components.
 2. Steel slotted channel systems. Include Product Data for components.
 3. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. Thomas & Betts Corporation; a member of the ABB Group.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

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 except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- D. 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. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 Spring-tension clamps.
 - 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.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. 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 033000 "Cast-in-Place Concrete." Or Section 033053 "Miscellaneous Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 1. Structural members in paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. IMC: Comply with ANSI C80.6 and UL 1242.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit IMC.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. ENT: Comply with NEMA TC 13 and UL 1653.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Continuous HDPE: Comply with UL 651B.
- F. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Fittings for LFNC: Comply with UL 514B.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R Type 4 Type 12 unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. Tele-Power Poles:
 - 1. Material: Galvanized steel with ivory baked-enamel finish.
 - 2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal 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. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular, as specified on the drawings.
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
 - 1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- M. Gangable boxes are allowed.
- N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated on the drawings.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- O. 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.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Standard: Comply with SCTE 77.
 2. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "ELECTRIC."
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
1. Standard: Comply with SCTE 77.
 2. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "ELECTRIC."
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: IMC or RNC, Type EPC-40-PVC.
 3. Underground Conduit: RNC, 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.
- 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. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.
- 3.2 INSTALLATION
- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
 - B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. 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 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to GRC or IMC before rising above floor.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch 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.

- N. 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.
- O. 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.
- P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- R. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 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 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg 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.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

- S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed 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.
- T. 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 top of box unless otherwise indicated.
- U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- W. Locate boxes so that cover or plate will not span different building finishes.
- X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Z. Set metal floor boxes level and flush with finished floor surface.
- AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

- 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
- 2. Install backfill as specified in Section 312000 "Earth Moving."
- 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
- 4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

- a. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch 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.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

PICNIC SHELTER & RESTROOMS AT
CHALLENGE GROVE PARK
CAMDEN COUNTY PARK
COMMISSION NO. 19M014

END OF SECTION 260533

SECTION 260539 - UNDERFLOOR RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flat-top, single- or multichannel, underfloor raceways.
2. Flush, flat-top underfloor raceways.
3. Cellular metal underfloor raceways.
4. Trench-type underfloor raceways.
5. Supports, raceway fittings, and hardware.
6. Junction boxes.
7. Service fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For underfloor raceway components, fittings, and accessories.

B. Shop Drawings: For underfloor raceways.

1. Include floor plans, elevations, sections, and details.
2. Identify components and accessories, such as expansion-joint assemblies, straight raceway lengths, preset and afterset inserts, and service fittings.
3. Provide dimensions locating raceway header and distribution elements. Include spacing between preset inserts and between preset inserts and ends of duct runs, walls, columns, junction boxes, and header duct connections.
4. Provide raceway fill charts for each duct size provided for each conductor size the duct is identified to accept.
5. Show connections between raceway elements and relationships between components and adjacent structural and architectural elements, including slab reinforcement, floor finish work, permanent partitions, expansion joints, architectural module lines, and pretensioning or post-tensioning components.
6. Indicate height of preset inserts, junction boxes, and raceways coordinated with depth of concrete slab and floor fill.
7. Indicate thickening of slabs where required for adequate encasement of raceway components.
8. Document coordination of exposed components with floor-covering materials to ensure that fittings and trim are suitable for indicated floor-covering material.
9. Revise locations from those indicated in the Contract Documents, as required to suit field conditions and to ensure a functioning layout. Identify proposed deviations from the Contract Documents.

10. Show details of connections and terminations of underfloor raceways at panelboards and communication terminal equipment in equipment rooms, wire closets, and similar spaces.
11. Identify those cells of cellular floor deck that are to be connected and fitted.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Project record documents.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Comply with UL 884.
- C. Comply with NFPA 70.

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.

2.2 FLAT-TOP, STEEL UNDERFLOOR RACEWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Square D.
 2. Thomas & Betts Corporation; a member of the ABB Group.
 3. Walker Systems, Inc.
- B. Source Limitations: Obtain underfloor raceway components for each system through single source from single manufacturer.

C. Description:

1. Material: One-piece, continuous weld, minimum 0.0598-inch- thick steel, with galvanized coating inside and out after welding.
2. Cross-Section Shape: Rectangular, with rounded corners.
3. Number of Longitudinal Channels: Two, separated by steel wall(s).
4. Minimum Bending Radius for Communication Cables: Combination of raceways, fittings, inserts, junction boxes, service fittings, and mounting and connection arrangements for wiring devices and jacks shall provide a 2-inch- minimum bending radius for communication cables.

D. Service Raceways: Fitted with preset inserts.

1. Nominal Multichannel Underfloor Raceway Dimensions:
 - a. Depth: 1-3/8 inches.
 - b. Power Service Channel Width: 3-1/2 inches.
 - c. Communication Service Channel Width: 6-1/2 inches.
2. Nominal Single-Channel Underfloor Raceway Dimensions:
 - a. Depth: 1-1/2 inches.
 - b. Power Service Raceway Width: 3-1/4 inches.
 - c. Communication Service Raceway Width: 6 inches.
3. Preset Inserts: Rectangular.
 - a. Spacing: 24 inches o.c.
 - b. Size: Rectangular dimensions as required to accommodate mounting and connection of flush- and surface-mounted, and multiple-outlet service fittings or to connect to wiring extensions for feeding wall outlets for power and communications.
 - c. Equip each insert with a disposable cover, and select insert height so cover is 1/8 inch below surface of concrete.
 - d. Arrange insert for optional attachment of flush-, surface-, or wiring-extension service fitting to replace disposable cover. Arrange brackets, mountings, barriers, and floor access covers to support, isolate, and provide access to flush or surface outlet-mounting connector, jack, and receptacle devices.

E. Header Raceways: Multichannel, without preset inserts (blank raceway).

1. Nominal Raceway Dimensions:
 - a. Depth: Same as service raceways.
 - b. Power Header Raceway Width: 3-1/2 inches.
 - c. Communication Header Raceway Width: 6-1/2 inches.
2. Arrangement: In same plane as service raceways.

3. Connections: Arranged to connect with service raceways at single-level junction boxes.

2.3 FLUSH, FLAT-TOP UNDERFLOOR RACEWAYS

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Source Limitations: Obtain underfloor raceway components for each system through single source from single manufacturer.
- C. Description:
 1. Material: Steel.
 2. Cross-Section Shape: Rectangular, single channel and multichannel, separated by steel wall(s).
 3. Listed and labeled for installation with top flush with concrete floor.
 4. Number of Levels: One.
- D. Service Raceways: Fitted with preset inserts.
 1. Number of Longitudinal Channels per Multichannel Raceway: Two.
 2. Number of Single-Channel Raceways per Run: Two unless otherwise indicated.
 3. Nominal Channel Dimensions: 3 inches wide by 1-1/4 inches deep.
 4. Preset Inserts: Threaded opening with removable steel plug that is flush with top of raceway when screwed in place.
 - a. Spacing: 24 inches o.c., full length of each service raceway.
 - b. Arrangement: Stagger insert locations on parallel raceways or channels to accommodate placement of adjacent service fittings.
 - c. Size: 1-5/8-inch diameter.
- E. Trench Duct Crossunder: Fitting attached to underside of trench duct.
 1. Nominal Channel Dimensions: Same as service raceways.
 2. Arrangement: Offset by depth of trench duct.
 3. Connections: Arranged to connect trench duct to flush duct through factory-cut, grommeted openings.
- F. Header Raceways: Raceways same as service raceways, except without preset inserts (blank raceway).
 1. Nominal Channel Dimensions: Same as service raceways.
 2. Arrangement: In same plane as service raceways.
 3. Connections: Arranged to connect with service raceways at junction boxes.

2.4 TRENCH-TYPE UNDERFLOOR RACEWAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Square D.
 - 2. Thomas & Betts Corporation; a member of the ABB Group.
 - 3. Walker Systems, Inc.
- B. Source Limitations: Obtain underfloor raceway components for each system through single source from single manufacturer.
- C. Trench: Steel, shop or factory welded and fabricated to indicated sizes. Include the following features:
 - 1. Slab Depth Adjustment: Minimum of minus 1/8 inch to plus 5/8 inch before and during concrete placement.
 - 2. Cover Supports: Height adjustable, with leveling screws to rigidly support cover assembly.
 - 3. Screed Strip: Extruded aluminum along both edges at proper elevation without requiring shim material.
 - 4. Trim Strip: Select to accommodate floor finish material.
 - 5. Partitions: Arranged to separate channels and isolate wiring of different systems.
 - 6. Manufacturer's standard corrosion-resistant finish, applied after fabrication.
- D. Cover Plates: Removable, steel plates, 1/4 inch thick, each weighing 60 lb or less with full gasket attached to side units. Fabricate intermediate supports to limit unsupported spans to 15 inches or less. Fabricate covers with appropriate depth recess to receive indicated floor finish.

2.5 SUPPORTS, RACEWAY FITTINGS, AND HARDWARE

- A. Source Limitations: Obtain underfloor raceway supports, fittings, and hardware components for each system through single source from single manufacturer.
- B. Supports, fittings, and hardware shall be compatible with raceway and outlet system and shall be listed for use with raceway systems and components delivered.
- C. Supports: Adjustable for height and arranged to maintain alignment and spacing of raceways during concrete placement. Include hold-down straps.
- D. Raceway Fittings: Couplings, expansion-joint sleeves, cross-under offsets, vertical and horizontal elbows, grounding screws, adapters, end caps, and other fittings suitable for use with basic components to form a complete installation.

2.6 JUNCTION BOXES

- A. Description: Raceway manufacturer's standard enclosure for indicated type, quantity, arrangement, and configuration of raceways at each raceway junction, intersection, and access location. Include the following accessories and features:
1. Mounting brackets.
 2. Escutcheons and holders to accommodate surrounding floor covering.
 3. Means for leveling and height adjustment more than 3/8 inch before and after concrete is placed.
 4. Boxes shall withstand a minimum 300-lb concentrated load. Internal supports shall be provided as needed to meet this requirement.
 5. All boxes shall provide 2-inch- minimum bend radius for data and communication cables.
 6. Raceway Openings: For underfloor raceways and conduits arranged to accommodate raceway layout.
 7. Covers shall have appropriate depth recess to receive specific floor finish material.
 8. Partitions to separate wiring of different systems.

2.7 SERVICE FITTINGS/ACTIVATIONS

- A. Source Limitations: Obtain underfloor raceway service fittings and hardware for each system through single source from single manufacturer.
- B. Exposed Parts Finish: Brushed aluminum or as otherwise shown on the drawings.
- C. Flush, Single-System Service Fitting for Round Inserts: Include mounting and cover to support and provide access to single connector, jack, or receptacle device; mounted flush with floor within body of insert.
- D. Flush, Multiple-System Service Fitting for Rectangular Inserts: Include mounting, hinged cover, and trim to support and provide access to connector, jack, or receptacle devices mounted flush with floor within insert.
- E. Surface-Mounted Service Fitting: Modular pedestal type, with locking attachment matched to insert floor opening.
1. Power-outlet, double-faced, surface-mounted unit for duplex receptacle on both sides.
 2. Power-outlet, single-faced, surface-mounted unit for duplex receptacle on one side.
 3. Communication-outlet, double-faced, surface-mounted unit.
 - a. Include provisions for modular dual jack-connector assembly, rated for Category 6 on both sides.
 4. Communication-outlet, single-faced, surface-mounted unit with bushed opening on one side; 1-inch minimum diameter; insulated with nonconducting material.
 5. Flush-Mounted Service Fittings: Modular fittings compatible with preset inserts and shall include covers, provisions for receptacles jacks and connector assemblies and wiring extensions to wall-mounted outlets, and associated device plates for indicated systems.

Include flush covers, recessed to suit floor finish material. Internally mounted, modular, receptacle, jack and connector assemblies shall comply with requirements in Section 262726 "Wiring Devices" and Section 271500 "Communications Horizontal Cabling."

6. Coordinate with Section 262726 "Wiring Devices" and Section 271500 "Communications Horizontal Cabling," and indicate types and locations of devices on Drawings.

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

3.2 INSTALLATION

- A. Install raceways aligned and leveled and, unless otherwise indicated, parallel or perpendicular to floor supports.
- B. Maintain arrangement of conductor services throughout the raceway system.
- C. Install a concrete mud slab for support of cellular metal, flush duct, or trench duct raceway. Construct mud slab with wire mesh in the top 1 inch of concrete.
- D. Install a vapor barrier between the cellular metal raceway and a substrate in contact with earth.
- E. Arrange supports to attain proper elevation, alignment, and spacing of raceways. Fasten supports securely at ends and at intervals not to exceed 60 inches, to prevent movement during concrete pour.
- F. Level raceway components with finished slab and make adjustments in raceway component elevation to accommodate indicated floor finishes.
- G. Junction Boxes: Install tops level and flush with finished floor. Install blank closure plates or plugs to close unused junction-box openings. Grout boxes in place to prevent movement during construction. Place top covers in inverted position during construction to prevent damage to surface of cover. Reinstall covers in proper position prior to final acceptance of the Work.
- H. Install preset inserts per manufacturer's instructions.
- I. Adjust supports to maintain a 1/8- to 3/8-inch finished concrete cover over preset inserts.

- J. Remove burrs, sharp edges, dents, and mechanical defects.
- K. Cap or plug boxes, insert- and service-fitting openings, and open ends of raceways.
- L. Install expansion fittings with suitable bonding jumper where raceways cross building expansion joints.
- M. Bond underfloor raceway components to create a continuous bonding path.
- N. Seal raceways, cells, junction boxes, and inserts, as recommended in writing by underfloor raceway manufacturer, to prevent water, concrete, or foreign matter from entering raceways before and during pouring slab or placing fill.
- O. Install a marker at the center of the last insert of each cell and channel of each straight run of metal underfloor service raceway to locate the insert and identify the system.
 - 1. Install markers at last inserts on both sides of permanent walls and at first inserts adjacent to each junction box.
 - 2. Use slotted-head screw to identify electrical power; use Phillips-head screw to identify conventional communications, and use another distinctive screw head to identify third system, such as special-purpose wiring.
- P. Protect underfloor raceway system from damage. Do not use the installed duct system as working platforms or walkways. Do not allow equipment or heavy traffic over duct during construction period, without first installing ramps over the duct. Ramps shall be designed so that imposed loads are not transferred to the duct. Components of the system that are damaged during construction shall be replaced.
- Q. Install concrete surrounding underfloor raceways according to Section 033000 "Cast-in-Place Concrete."
- R. Afterset Inserts: Cut, hole saw, and drill slab and raceways to allow for installation at locations indicated on plans.
- S. Wiring shall comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and NFPA 70 requirements for wet locations.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:

1. Perform visual inspection of interior of each junction box to verify absence of dirt, dust, construction debris, and moisture. Replace damaged and malfunctioning components.
 2. Prior to and after concrete pour, perform point-to-point tests of ground continuity and resistance of ground path between the most remote accessible fitting on each branch of each underfloor raceway system and the main electrical distribution grounding system.
 - a. Determine cause and perform correction of any point-to-point resistance value that exceeds 0.05 ohms.
 - b. Comply with NETA Acceptance Testing Specification about safety, suitability of test equipment, test instrument calibration, and test report and records.
- D. Prepare test and inspection reports.

3.4 CLEANING

- A. Clean and swab out underfloor raceways, inserts, and junction boxes after finish has been applied to floor slab, and remove foreign material, dirt, and moisture. Leave interiors clean and dry.

END OF SECTION 260539

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 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.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 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. 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. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

- A. Description: Nonshrink; 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.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

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. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and 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 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- 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.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
 2. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
1. Black letters on an orange field.
 2. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
 - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

C. Tag: For Electric and Communications.

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench [or concrete envelope]exceeds 16 inches overall.
- G. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

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1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- K. 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 load shedding.
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. 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.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label Stenciled legend 4 inches high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Short-Circuit Study Specialist.

1.4 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 Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. 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.
- D. 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. Comply with IEEE 399 and IEEE 551.
- B. Analytical features of fault-current-study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

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.
- 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.
- B. Gather and tabulate the following input data to support the short-circuit study:
 - 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. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 - 8. Motor horsepower and NEMA MG 1 code letter designation.
 - 9. 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. 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.
- E. 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.
- F. The calculations shall include the ac fault-current decay from induction motors. 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.
- G. 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. Low-voltage switchgear.
 - 4. Motor-control centers.
 - 5. Control panels.
 - 6. Automatic transfer switches.
 - 7. Branch circuit panelboards.
 - 8. Disconnect switches.
 - 9. <Insert significant locations in the system>.

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 260572

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy and switchbox-mounted occupancy sensors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- ##### A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- ##### A. Operation and maintenance data

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- ##### A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.

3. Leviton Manufacturing Co., Inc.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Contact Configuration: SPST.
 3. Contact Rating: 30-A inductive or resistive, 240-V ac.
 4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 6. Astronomic Time: Selected channels.
 7. Automatic daylight savings time changeover.
 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. Tyco Electronics.
- B. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
 3. Time Delay: Thirty-second minimum, to prevent false operation.
 4. Lightning Arrester: Air-gap type.

5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.3 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Hubbell Building Automation, Inc.
 2. Leviton Manufacturing Co., Inc.
 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
 4. Sensor Switch, Inc.
 5. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. Bypass Switch: Override the "on" function in case of sensor failure.

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8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
- D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
- E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Hubbell Building Automation, Inc.
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 4. Sensor Switch, Inc.
 - 5. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 - 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
 - 4. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 - 5. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 - 6. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.5 LIGHTING CONTACTORS

- A. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to 3 visits to Project during other-than-normal occupancy hours for this purpose.
 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
- C. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.
- D. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- E. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lighting control devices will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Panelboard schedules for installation in panelboards.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression 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 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus Configured Terminators: Mechanical type.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Eaton Electrical Sector; Eaton Corporation.
 2. Schneider Electric USA, Inc.
 3. Siemens Industry, Inc.
 4. Square D.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

- F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker or lugs only.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. External Control-Power Source: 120-V branch circuit.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I squared x 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 two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: Circuit-breaker-mounted Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- I. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Wall-switch and exterior occupancy sensors.
6. Communications outlets.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Wiring Devices, Inc.
 - 2. Hubbell.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 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. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

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. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Single Pole:
 - 1) Cooper;
 - 2) Hubbell;
 - 3) Leviton;
 - 4) Pass & Seymour;
 - b. Two Pole:
 - 1) Cooper;
 - 2) Hubbell;
 - 3) Leviton;
 - 4) Pass & Seymour;
 - c. Three Way:

- 1) Cooper;
- 2) Hubbell;
- 3) Leviton;
- 4) Pass & Seymour;

d. Four Way:

- 1) Cooper;
- 2) Hubbell;
- 3) Leviton;
- 4) Pass & Seymour;

C. Pilot-Light Switches, 20 A:

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. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:

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. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.6 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

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. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
- B. GFCI, Feed-Through Type, Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and UL 943 Class A.
 - 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. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
- C. Toggle Switches, Square Face, 120/277 V, 20 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 - 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. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
- D. Lighted Toggle Switches, Square Face, 120 V, 20 A: Comply with NEMA WD 1 and UL 20.
 - 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. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: With neon-lighted handle, illuminated when switch is "off."

2.7 RESIDENTIAL DEVICES

- A. Fan Speed Controls:

1. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters.
2. Comply with UL 1917.
3. Continuously adjustable slider, 5 A.
4. Three-speed adjustable slider, 1.5 A.

B. Telephone Outlet:

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. Cooper Wiring Devices, Inc.
 - b. Leviton Manufacturing Co., Inc.
2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6a. Comply with UL 1863.

C. Combination TV and Telephone Outlet:

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. Cooper Wiring Devices, Inc.
 - b. Leviton Manufacturing Co., Inc.
2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6a. Comply with UL 1863.

2.8 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 1. 600 W; dimmers shall require no derating when ganged with other devices.

- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.9 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel, unless otherwise indicated on the drawings.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.10 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. TVSS Devices: Blue.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:

PICNIC SHELTER & RESTROOMS AT
CHALLENGE GROVE PARK
CAMDEN COUNTY PARK
COMMISSION NO. 19M014

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. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- 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 service poles to suit arrangement of partitions and furnishings.
- 3.2 GFCI RECEPTACLES
- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.
- 3.3 FIELD QUALITY CONTROL
- A. Perform the following tests and inspections:
1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:

PICNIC SHELTER & RESTROOMS AT
CHALLENGE GROVE PARK
CAMDEN COUNTY PARK
COMMISSION NO. 19M014

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.
- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Motor-control centers.
 - c. Panelboards.
 - d. Switchboards.
 - e. Enclosed controllers.
 - f. Enclosed switches.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Cooper Bussmann; a division of Cooper Industries.
 2. Edison; a brand of Cooper Bussmann; a division of Cooper Industries.
 3. Littelfuse, Inc.
 4. Mersen USA.

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: 600-V, zero- to 600-A rating, 200 kAIC.
 2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC.
 3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC.
 4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC.
 5. Type J: 600-V, zero- to 600-A rating, 200 kAIC.
 6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC.
 7. Type T: 250-V, zero- to 1200-A 600-V, zero- to 800-A rating, 200 kAIC.
- 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 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Architect.

3.2 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "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 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Enclosures.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Wiring Devices, Inc.
 - 2. Eaton Electrical Sector; Eaton Corporation.
 - 3. Siemens Industry, Inc.
 - 4. Square D.
- B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate indicated fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Cooper Wiring Devices, Inc.
 2. Eaton Electrical Sector; Eaton Corporation.
 3. Siemens Industry, Inc.
 4. Square D.
- B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Lugs: Suitable for number, size, and conductor material.

2.3 RECEPTACLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Eaton Electrical Sector; Eaton Corporation.
 2. Siemens Industry, Inc.
 3. Square D.

- B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 600-V ac; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 600-V ac; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
- E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.4 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Bussmann; a division of Cooper Industries.
 - 2. Littelfuse, Inc.
 - 3. Mersen USA.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight ON pilot light.
 - 3. Isolated neutral lug.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
 - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.5 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.
 - 2. Siemens Industry, Inc.
 - 3. Square D.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
- E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- F. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 6. 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.
 - 7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Kitchen or 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Comply with requirements in Section 260553 "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.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each enclosed switch and circuit breaker, 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 stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

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- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262816

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 SUBMITTALS

- A. Product Data: For each type of product, arranged by designation.
- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:
- B. Product Certificates: For each type of luminaire.
- C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Recessed Fixtures: Comply with NEMA LE 4.
- C. CRI of minimum 80. CCT of 3500k.
- D. Rated lamp life of 50,000 hours.
- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- F. Internal driver.
- G. Nominal Operating Voltage: as specified on the drawings.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- H. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Clear powder-coat finish.

2.2 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.

3. Form and support to prevent warping and sagging

- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers, and Globes:
 - 1. prismatic acrylic
 - 2. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Clear powder-coat finish.

2.3 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.

2.4 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch 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 INSTALLATION

- A. Comply with NECA 1.

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- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports: Sized and rated for luminaire weight.
- E. Flush-Mounted Luminaire Support: Secured to outlet box.
- F. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
- G. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. 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.

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