Sheldon Neeley
Mayor

REQUEST FOR PROPOSALS

PROPOSAL NO. 26000522

Publish Date: 10/27/25

The City of Flint, Finance Department of Purchases & Supplies, is soliciting sealed bids for providing:

RECONSTRUCTION OF LIFT STATION 5 – WATER POLLUTION CONTROL

Per the attached additional requirements**.**

If your firm is interested in providing the services requested, please submit:

Submit to City:
1 original, printed, signed, original proposals and signed addenda
2 additional copies unbound
1 electronic copy

Please follow the following bid timeline.

Pre-Bid Meeting

A mandatory pre-bid meeting will occur Wednesday, **November 5, 2025, at the Water Pollution Control Facility, 4652 Beecher Rd, Flint, MI, 48532 at 10am EST**. Please confirm attendance with John Florshinger, SCADA Supervisor at jflorshinger@cityofflint.com or **810-577-8909** by **Tuesday, November 4, 2025 at 1pm EST**. Failure to attend may result in disqualification of your bid.

Questions

All written questions shall be directed Lauren Rowley, Purchasing Manager by **Friday, November 7, 2025,** by **10am EST** to lrowley@cityofflint.com.

Bid Submission Requirements

1. The mail in **HARD COPY** with the original signature (signed documents) must be received by **Tuesday, November 25, 2025, by 11:00 A.M. (EST), City of Flint, Finance Department - Division of Purchases and Supplies, 1101 S. Saginaw St., Room 203, Flint, MI, 48502.** Bids must be in a sealed envelope clearly identifying the proposal name and proposal number.
2. **Electronic Copies** are being accepted on the BidNet Direct platform. Please submit them by **Tuesday, November 25, 2025, by 11:00 A.M.** (EST).
   - **An electronic bid submission user guide can be found here: https://faq.bidnetdirect.com/electronic-bid-submission.**
   - **Bidnet Direct's Vendor Support team is available M-F from 8 a.m. – 8 p.m. ET. You can contact them at (800) 835-4603 or support@bidnet.com.**
   - Emailed copies may be submitted to **PurchasingBids@cityofflint.com** in the event of technical error. Pease note that in the subject line of the email, type in the proposal name and number. This must be submitted by the due date and time.
3. Faxed bids are not accepted.
4. Both mail in proposal and electronic submittal must be received by the due date and time.

Bid Opening

Tuesday, November 25 · 11:00 – 11:30am
Time zone: America/New_York
Google Meet joining info

Video call link: https://meet.google.com/vok-fwgx-kfd
Or dial: (US) +1 609-479-1482 PIN: 856 774 965#
More phone numbers: https://tel.meet/vok-fwgx-kfd?pin=2811410683519
Any additional proposal documents, requirements, addendums, specifications, and plans/drawings (if utilized) are available on the Purchasing page of the City of Flint's web site at https://www.cityofflint.com/purchasing/.

Effective immediately upon release of these Bidding Documents, and until notice of contract award, all official communications from proposers regarding the requirements of this Bid shall be directed to:

Lauren Rowley
810-766-7266 ext. 2904
lrowley@cityofflint.com

The City, or designee, shall distribute all official changes, modifications, responses to questions or notices relating to the requirements of this Bid. Addendum to this Bid may be developed and shared with all Vendors. Any other information of any kind from any other source shall not be considered official, and proposers relying on other information do so at their own risk.

NOTICE TO VENDOR Offers, subject to the conditions made a part hereof, will be received at this office, ***1101* S. *Saginaw St., Flint, Ml 48502 for the following:***

City of Flint has partnered with BidNet as part of the MITN Purchasing Group (branded page link) to post bid opportunities to this site. As a vendor, you can register with the MITN Purchasing Group and be sure that you see all available bids and opportunities. By selecting automatic bid notification, your company will receive emails once the City of Flint has a bid opportunity that matches your company's business. In addition, the site handles bid opportunities, RFPs, and RFQs for other member governmental agencies throughout Michigan. The City of Flint looks forward to providing you with more bid information and simplifying the entire bid, proposal, and quote processes for everyone involved. We appreciate your cooperation and welcome your participation. If you need help registering, please call the MITN Purchasing Group support department toll free 1-800-835-4603 option #2.

Link to City of Flint open solicitations:
MITN Purchasing Group (branded page link)

INSTRUCTIONS TO VENDORS

1) **PRE-BID INFORMATION AND QUESTIONS:** Each bid that is timely received will be evaluated on its merit and completeness of all requested information. In preparing bids, Bidders are advised to rely only upon the contents of this Request for Proposals (RFP) and accompanying documents and any written clarifications or addenda issued by the City of Flint. If a Bidder finds a discrepancy, error or omission in the RFP package, or requires any written addendum thereto, the Bidder is requested to notify the Purchasing contact noted on the cover of this RFP, so that written clarification may be sent to all prospective Bidders. **THE CITY OF FLINT IS NOT RESPONSIBLE FOR ANY ORAL INSTRUCTIONS**. All questions must be submitted in writing to the Finance Department of Purchases and Supplies before any pre-bid deadline (if specified) or at least one (1) week prior to the proposal opening date indicated on the front of this document.

2) **RFP MODIFICATIONS:** The City of Flint has the right to correct, modify or cancel the RFP, in whole or in part, or to reject any Bid, in whole or in part, within the discretion of the City of Flint, or their designee. If any such changes are made, all known recipients of the RFP will be sent a copy of such changes. If any changes are made to this RFP document by any party other than the City of Flint, the original document in the City of Flint's files takes precedence.

3) **PROPOSAL SUBMISSION:**

a) The Bidder must include the following items, or the proposal may be deemed non-responsive:

i) All forms contained in this RFP, fully completed.

b) Bids must be submitted to the Finance Department of Purchases and Supplies, City of Flint, 1101 S. Saginaw Street, Room 203, Flint, Michigan 48502 by the date and time indicated as the deadline**.** The Purchasing Department time stamp will determine the official receipt time. It is each Bidder's responsibility to insure that their proposal is time stamped by the Purchasing Department by the deadline. This responsibility rests entirely with the Bidder, regardless of delays resulting from postal handling or for any other reasons. Proposals will be accepted at any time during the normal course of business only, said hours being 8:00 a.m. to 5:00 p.m. local time, Monday through Friday, legal holidays as exception.

c) Bids must be enclosed in a sealed, non-transparent envelope, box or package, and clearly marked on the outside with the following: RFP Title, RFP Number, Deadline and Bidder's name.

d) Submission of a bid establishes a conclusive presumption that the Bidder is thoroughly familiar with the Request for Proposals (RFP), and that the Contractor understands and agrees to abide by each and all of the stipulations and requirements contained therein.

e) All prices and notations must be typed or printed in ink. No erasures are permitted. Mistakes may be crossed out and corrections must be initialed in ink by the person(s) signing the bid.

f) Proposals sent by email, facsimile, or other electronic means will not be considered unless specifically authorized in this RFP.

g) All costs incurred in the preparation and presentation of the bid are the Bidder's sole responsibility; no pre-bid costs will be reimbursed to any Bidder. All documentation submitted with the proposal will become the property of the City of Flint.

h) Proposals must be held firm for a minimum of 120 days.

4) **EXCEPTIONS:** Bidder shall clearly identify any proposed deviations from the Terms or Scope in the Request for Proposals. Each exception must be clearly defined and referenced to the proper paragraph in this RFP. The exception shall include, at a minimum, the proposed substitute language and opinion as to why the suggested substitution will provide equivalent or better service and performance. If no exceptions are noted in the bid, the City of Flint will assume complete conformance with this specification and the successful Bidder will be required to perform accordingly. Bids not meeting all requirements may be rejected.

5) **DUPLICATE BIDS:** No more than one (1) bid from any Bidder including its subsidiaries, affiliated companies and franchises will be considered by the City of Flint. In the event multiple proposals are submitted in violation of this provision, the City will have the right to determine which bid will be considered or, at its sole option, reject all such multiple proposals.

6) **WITHDRAWAL:** Bids may only be withdrawn by written notice prior to the date and time set for the opening of bids. No bid may be withdrawn after the deadline for submission.

7) **REJECTION/GOOD STANDING:** The City of Flint reserves the right to reject any or all bids, or to accept or reject any bid in part, and to waive any minor informality or irregularity in bids received if it is determined by the City of Flint, or their designee, that the best interest of the City will be served by doing so. No bid will be considered from any person, firm or corporation in arrears or in default to the City on any contract, debt, taxes or other obligation, or if the Bidder is debarred by the City of Flint from consideration for a contract award pursuant to Section 18-21.5 (d) of Article IV of the "Purchasing Ordinance of the City of Flint".

8) **PROCUREMENT POLICY:** Procurement for the City of Flint will be handled in a manner providing fair

opportunity to all businesses. This will be accomplished without abrogation or sacrifice of quality and as determined to be in the best interest of the City. The City of Flint and their officials have the vested authority to execute a contract, subject to City Council and Mayoral approval where required.

9) **BID SIGNATURES:** Bids must be signed by an authorized official of the Bidder. Each signature represents binding commitment upon the Bidder to provide the goods and/or services offered to the City of Flint if the Bidder is determined to be the lowest Responsive and Responsible Bidder.

10) **CONTRACT AWARD/SPLIT AWARDS:** The City of Flint reserves the right to award by item and/or group of items. The Bidder to whom the award is made will be notified at the earliest possible date. Tentative acceptance of the bid, intent to recommend award of a contract and actual award of the contract will be provided by written notice sent to the Bidder at the address designated in the bid if a separate Agreement is required to be executed. After a final award of the Agreement by the City of Flint, the Contractor/Vendor must execute and perform said Agreement. All proposals must be firm for at least 120 days from the due date of the proposal. If, for any reason, a contract is not executed with the selected Bidder within 14 days after notice of recommendation for award, then the City may recommend the next lowest responsive and responsible Bidder.

11) **NO RFP RESPONSE:** Bidders who receive this RFP but who do not submit a bid should return this RFP package stating "No Bid" and are encouraged to list the reason(s) for not responding. Failure to return this form may result in removal of the Bidder's name from all future lists.

12) **FREEDOM OF INFORMATION ACT (FOIA) REQUIREMENTS:** Bids are subject to public disclosure after the deadline for submission in accordance with state law.

13) **ARBITRATION:** Contractor/Vendor agrees to submit to arbitration all claims, counterclaims, disputes and other matters in question arising out of or relating to this agreement or the breach thereof. The Contractor's/Vendor's agreement to arbitrate shall be specifically enforceable under the prevailing law of any court having jurisdiction to hear such matters. Contractor's/Vendor's obligation to submit to arbitration shall be subject to the following provisions:

    a) Notice of demand for arbitration must be submitted to the City in writing within a reasonable time after the claim, dispute or other matter in question has arisen. A reasonable time is hereby determined to be fourteen (14) days from the date the party demanding the arbitration knows or should have known the facts giving rise to their claim, dispute or question. In no event may the demand for arbitration be made after the time when institution of legal or equitable proceedings based on such claim dispute or other matters in question would be barred by the applicable statute of limitation.

    b) Within fourteen (14) days from the date that demand for arbitration is received by the City, each party shall submit to the other the name of one person to serve as an arbitrator. The two arbitrators together shall then select a third person, the three together shall then serve as a panel in all proceedings. Any decision concurred in by a majority of the three shall be a final binding decision.

    c) The final decision rendered by said arbitrators shall be binding and conclusive and shall be subject to specific enforcement by a court of competent jurisdiction.

    d) The costs of the arbitration shall be split and borne equally between the parties and such costs are not subject to shifting by the arbitrator.

    e) This provision shall survive the expiration or termination of this Agreement in perpetuity.

14) **BID HOLD:** The City of Flint may hold bids for a period of one hundred twenty (120) days from opening, for the

purpose of reviewing the results and investigating the qualifications of bidders prior to making an award.

15) **NONCOMPLIANCE:** Failure to deliver in accordance with specifications will be cause for the City of Flint and they may cancel the contract or any part thereof and purchase on the open market, charging any additional cost to the Contractor/Vendor.

16) **DISCLAIMER OF CONTRACTUAL RELATIONSHIP:** Nothing contained in these documents shall create any contractual relationship between the City and any Subcontractor or Sub-subcontractor.

17) **ERRORS AND OMISSIONS:** Bidder is not permitted to take advantage of any obvious errors or omissions in specifications**.**

18) **INTERPRETATION:** In the event that any provision contained herein shall be determined by a court of competent jurisdiction or an appropriate administrative tribunal to be contrary to the provision of law or to be unenforceable for any reason, then, to the extent necessary and possible to render the remainder of this Agreement enforceable, such provision may be modified or severed by such court or administrative tribunal having jurisdiction over this Agreement and the interpretation thereof, or the parties hereto, so as to, as nearly as possible, carry out the intention of the parties hereto, considering the purpose of the entire Agreement in relation to such provision.

19) **LAWS AND ORDINANCES:** The Bidder shall obey and abide by all of the laws, rules and regulations of the Federal Government, State of Michigan, Genesee County and the City of Flint, applicable to the performance of this Agreement, including, but not limited to, labor laws, and laws regulating or applying to public improvement, local government, and its operational requirements.

20) **LOCAL PREFERENCE:** Contractors/bidders located within the corporate city limits of Flint, Michigan may be given a seven percent (7%) competitive price advantage. Additionally, if the lowest responsible bidder is not located within the limits of the City of Flint, but is located within the County of Genesee, and said bidder does not exceed the bid of the lowest non-local bidder by more than three and one-half percent (3-1/2%), then said lowest Genesee County bidder may be determined to be the lowest responsible bidder, and make the award to such Genesee County bidder accordingly, subject to the approval of the City Council. If the lowest non-local bidder does not exceed that of any Proposers/bidders by (7%) inside the City of Flint or (3-1/2%) inside the County of Genesee, then the Purchasing Director shall be allowed to request that the lowest local vendor match the price offered by the lowest non-local vendor.

21) **MATERIAL WORKMANSHIP AND STANDARDS OF PERFORMANCE:** The Bidder agrees to exercise independent judgment and to complete performance under this Agreement in accordance with sound professional practices. In entering into this Agreement, the City is relying upon the professional reputation, experience, certification and ability of the Bidder by her/him/themselves or by others employed by her/him/them and working under their direction and control. The continued effectiveness of this Agreement during its term or any renewal term shall be contingent, in part, upon the Bidder maintaining her/his/their operating qualifications in accordance with the requirements of federal, state and local laws. All materials furnished must be new, of latest model and standard first grade quality, or best workmanship and design, unless otherwise expressly specified. Bidder, if required, must furnish satisfactory evidence of quality materials; offers of experimental or unproven equipment may be disregarded.

22) **MODIFICATIONS/CHANGES:** Any modification to this agreement must be in writing and signed by the authorized employee, officer, board or council representative authorized to make such modifications pursuant to the State law and local ordinances.

23) **NON-COLLUSION:** The Bidder acknowledges that by signing this document that she/he/they is/are duly authorized to make said offer on behalf of the company she/he/they represent(s) and that said bid is genuine and not sham or collusive and not made in the interests or on behalf of any person not therein named, and that

she/he/they and said bidder have not directly induced or solicited any other person(s) or corporation to refrain from responding to this solicitation and that she/he/they and said bidder have not in any manner sought by collusion to secure to themselves and said bidder any advantage over any other bidder.

24) **NON-DISCRIMINATION:** Pursuant to the requirements of 1976 P.A. 453 (Michigan Civil Rights Act) and 1976 P.A. 220 (Michigan Handicapped Rights Act), the local unit and its agent agree not to discriminate against any employee or applicant for employment with respect to hire, tenure, terms, conditions, or privileges of employment or a matter directly or indirectly related to employment because of race, color, religion, national origin, age, sex, height, weight, marital status or because of a handicap that is unrelated to the person's ability to perform the duties of nondiscrimination provision identical to this provision and binding upon any and all contractors and subcontractors. A breach of this covenant shall be regarded as a material breach of this contract.

25) **SUBCONTRACTING:** No subcontract work shall be started prior to the written approval of the subcontractor by the City. The City reserves the right to accept or reject any subcontractor.

26) **UNION COMPLIANCE:** Bidder agrees to comply with all regulations and requirements of any national or local union(s) that may have jurisdiction over any of the materials, facilities, services or personnel to be furnished by the City.

27) **WAIVER:** Failure of the City to insist upon strict compliance with any of the terms, covenants or conditions of this Agreement shall not be deemed a waiver of that term, covenant or condition or of any other term, covenant or condition. Any waiver or relinquishment of any right or power hereunder at any one or more times shall not be deemed a waiver or relinquishment of that right or power at any other time.

28) **CITY INCOME TAX WITHHOLDING:** Contractor and any subcontractor engaged in this contract shall withhold from each payment to his employees the City income tax on all of their compensation subject to tax, after giving effect to exemptions, as follows:

    a) Residents of the City:
    At a rate equal to 1% of all compensation paid to the employee who is a resident of the City of Flint.

    b) Non-residents:
    At a rate equal to 1/2% of the compensation paid to the employee for work done or services performed in the City of Flint.

    These taxes shall be held in trust and paid over to the City of Flint in accordance with City ordinances and State law. Any failure to do so shall constitute a substantial and material breach of this contract.

29) **CONTRACT DOCUMENTS:** The invitation for proposal, instructions to proposal, proposal, affidavit, addenda (if any), statement of Bidder's qualifications (when required), general conditions, special conditions, performance bond, labor and material payment bond, insurance certificates, technical specifications, and drawings, together with this agreement, form the contract, and they are as fully a part of the contract as if attached hereto or repeated herein.

30) **DISCLAIMER OF CONTRACTUAL RELATIONSHIP WITH SUBCONTRACTORS:** Nothing contained in the Contract Documents shall create any contractual relationship between the City and any Subcontractor or Sub-subcontractor.

31) **EFFECTIVE DATE:** Any agreement between the City and the Bidder shall be effective upon the date that it is executed by all parties hereto.

32) **FORCE MAJURE:** Neither party shall be responsible for damages or delays caused by Force Majeure nor other events beyond the control of the other party and which could not reasonably have anticipated the control of the other party and which could not reasonably have been anticipated or prevented. For purposes of this

Agreement, Force Majeure includes, but is not limited to, adverse weather conditions, floods, epidemics, war, riot, strikes, lockouts, and other industrial disturbances; unknown site conditions, accidents, sabotage, fire, and acts of God. Should Force Majeure occur, the parties shall mutually agree on the terms and conditions upon which the services may continue.

33) **INDEMNIFICATION:** To the fullest extent permitted by law, Bidder agrees to defend, pay on behalf of, indemnify, and hold harmless the City of Flint, its elected and appointed officials, employees and volunteers and others working on behalf of the City of Flint, including the Project Manager, against any and all claims, demands, suits, or losses, including all costs connected therewith, and for any damages which may be asserted, claimed, or recovered against or from the City of Flint, its elected and appointed officials, employees, volunteers or others working on behalf of the City of Flint, by reason of personal injury, including bodily injury or death and/or property damage, including loss of use thereof, which may arise as a result of Bidder's acts, omissions, faults, and negligence or that of any of his employees, agents, and representatives in connection with the performance of this contract. Should the Bidder fail to indemnify the City in the above-mentioned circumstances, the City may exercise its option to deduct the cost that it incurs from the contract price forthwith. These provisions shall survive the termination or expiration of any agreement entered into as a result of this request.

34) **INDEPENDENT CONTRACTOR:** No provision of this contract shall be construed as creating an employer-employee relationship. It is hereby expressly understood and agreed that Bidder is an "independent contractor" as that phrase has been defined and interpreted by the courts of the State of Michigan and, as such, Bidder is not entitled to any benefits not otherwise specified herein.

35) **NO THIRD-PARTY BENEFICIARY:** No contractor, subcontractor, mechanic, material man, laborer, vendor, or other person dealing with the principal Contractor shall be, nor shall any of them be deemed to be, third-party beneficiaries of this contract, but each such person shall be deemed to have agreed (a) that they shall look to the principal Contractor as their sole source of recovery if not paid, and (b) except as otherwise agreed to by the principal Contractor and any such person in writing, they may not enter any claim or bring any such action against the City under any circumstances. Except as provided by law, or as otherwise agreed to in writing between the City and such person, each such person shall be deemed to have waived in writing all rights to seek redress from the City under any circumstances whatsoever.

36) **NON-ASSIGNABILITY:** Contractor shall not assign or transfer any interest in this contract without the prior written consent of the City provided, however, that claims for money due or to become due to Contractor from the City under this contract may be assigned to a bank, trust company, or other financial institution without such approval. Notice of any such assignment or transfer shall be furnished promptly to the City.

37) **NON-DISCLOSURE/CONFIDENTIALITY:** Contractor agrees that the documents identified herein as the contract documents are confidential information intended for the sole use of the City and that Contractor will not disclose any such information, or in any other way make such documents public, without the express written approval of the City or the order of the court of appropriate jurisdiction or as required by the laws of the State of Michigan.

38) **RECORDS PROPERTY OF CITY:** All documents, information, reports and the like prepared or generated by Contractor as a result of this contract shall become the sole property of the City of Flint.

39) **SEVERABILITY:** In the event that any provision contained herein shall be determined by a court or administrative tribunal to be contrary to a provision of state or federal law or to be unenforceable for any reason, then, to the extent necessary and possible to render the remainder of this Agreement enforceable, such provision may be modified or severed by such court or administrative tribunal so as to, as nearly as possible, carry out the intention of the parties hereto, considering the purpose of the entire Agreement in relation to such provision. The invalidation of one or more terms of this contract shall not affect the validity of the remaining terms.

40) **TERMINATION:** This contract may be terminated by either party hereto by submitting a notice of termination to the other party. Such notice shall be in writing and shall be effective 30 days from the date it is submitted unless otherwise agreed to by the parties hereto. Contractor, upon receiving such notice and prorated payment upon termination of this contract shall give to the City all pertinent records, data, and information created up to the date of termination to which the City, under the terms of this contract, is entitled.

41) **TIME PERFORMANCE:** Contractor's services shall commence immediately upon receipt of the notice to proceed and shall be carried out forthwith and without reasonable delay.

42) **EVALUATION OF PROPOSAL:** In the City's evaluation of proposals, at minimum: cost, serviceability, financial stability, and all requirements set forth in this document shall be considered as selection and award criteria unless otherwise specified.

43) **PREVAILING WAGE:** When applicable, all work for this project, including that of any subcontractor or sub-subcontractor, must meet Davis-Bacon Act requirements and full prevailing wage. Information on Davis-Bacon reporting and requirements, including payroll reporting, can be found at: **https://www.dol.gov/whd/govcontracts/dbra.htm**

44) **INSURANCE & BONDS:** The bidder whose proposal is accepted will be required to furnish bonds and evidence of insurance within five days from date of Notice of Award. In case of failure or refusal on the part of the bidder to furnish bonds, if required, within the set period, the amount of deposit may be forfeited to the county and the contract may be awarded to the next lowest responsible bidder. Upon the notification of award and approval of the bond, the deposit will be returned to the proposer. The deposit of persons other than the one to whom and award is made will be returned to the person or persons making the proposal immediately after the contract and bonds have been executed.

45) **PROPOSAL SUBMISSION:** Proposals and all information requested of the vendor shall be entered in the appropriate spaces. Failure to do so may disqualify the vendor's offer. An authorized officer or employee of the bidder shall submit the proposal.

46) **PRICES:** Prices proposed shall be for new products in current production unless otherwise specified. Where refurbished or discontinued items are offered they must be clearly identified as such. Prices proposed shall be exclusive of any rebates due the City. Any rebates the City may be entitled to should be shown as a separate line item and include expiration date.
Corrections and/or modifications received after the bid closing time specified will not be accepted. Unit prices prevail.
All prices will be bid F.O.B. DESTINATION, INCLUDE ALL DELIVERY AND ANY ADDITIONAL CHARGES, and remain in effect as specified in the quotation.

47) **AWARD:** Unless otherwise stated in the proposal documents, the City cannot guarantee exclusivity of the contract for the proposed products or services.
Award of the proposal shall be based upon a combination of factors, including but not limited to, adherence to proposal requirements, references and any other factors that may be in the City's best interest. The City reserves the right to reject any and all bids, and to waive any defect or irregularity in bids. The City reserves the right to accept and separate items in the bid;
and to accept the proposal that in the opinion of the City is to the best advantage and interest of the public we serve. The City also has the right to re-solicit bids if it is deemed to be in the best interest of the City.
The City reserves the right to reject low bids which have major deviations from our specification; to accept a higher quotation which has only minor deviations. By signing the bid, the vendor agrees to accept a split award unless the awarded vendor clearly indicates that it takes exception. The bid will be awarded to that responsible, responsive bidder whose proposal conforms to this solicitation, and will be most

advantageous to the City, with regard not only to price, but also to availability of product, location and quality of product considered.

The City reserves the right to award all line items, to make no award or to award on an individual line item basis, whichever is deemed to be in the best interest of the City.

Time of delivery may be a consideration in the award.

48) **ETHICS IN PURCHASING:** Bidders and proposers are required to comply with Flint City Ordinance 3865 in its entirety. It is incumbent upon and the responsibility of the bidder to become familiar with and comply with the Purchasing ordinances as outlined in 3865 covering chapter 18 of the Flint City Ordinances. Bidder/Proposer acknowledges in accordance with Flint City Ordinance Section 18-21.19 Ethics in Purchasing, any and all communication about the bid selection process should be directed to those City employees delegated with the authority with respect to all purchases of goods and services.

Bidder/Proposer acknowledges and agrees that while a procurement is pending, bidders and proposers shall not communicate about the solicitation with any City employee, agent, or elected official, other than the purchasing director or other City personnel identify in the solicitation. This means that bidder and proposer are prohibited from communicating orally or by written communications, including but not limited to voicemail messages, social media, email, in person, among any other form of communication while the award is pending, to the aforementioned, with the exception to those employees designated by the City. If you are unclear about the process, it is your duty and obligation to contact the designated employee(s) for clarification.

Violations of the ethics provision of the ordinance, without regard to if the violation rises to the level of a criminal violation, may subject the bidder or proposer to debarment.

49) **BID PROTESTS:** If Bidder/Proposal believe that they are aggrieved in connection with the solicitation or award of the purchase order or contract, they may protest the action to the City as outlined in Flint City Charter Section 18-21.15.

THE FOLLOWING PAGES MUST BE COMPLETED AND INCLUDED WITH SUBMITTAL IN THE FOLLOWING ORDER.

Purchasing Checklist:

□ Exhibit A - Complete Proposal Submittal with detailed Summary of Pricing
□ Exhibit B –Qualifications and Licenses Requirements
□ Exhibit C – Disclosure of Supplier Responsibility Statement
□ Exhibit D - List of References
□ Exhibit E - Certificate of Insurance
□ Exhibit F – Non-Bidder's Response
□ Exhibit G – City of Flint Affadavit

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❖ EXHIBIT A - SUBMITTAL WITH DETAILED SUMMARY OF PRICING

SCOPE OF WORK ATTACHED SEPARATELY.

1. Failure to use this bid form shall result in bid disqualification.
2. Failure to bid on all items shall result in an "incomplete bid" determination.
3. List value-added considerations on a separate sheet of paper.
4. All bid pricing to include shipping and freight charges.

THIS PAGE MUST BE COMPLETED AND INCLUDED WITH THE BID

The undersigned hereby certifies, on behalf of the respondent named in this Certification (the "Respondent"), that the information provided in this offer submitted to the City of Flint, Department of Purchase and Supplies is accurate and complete, and that I am duly authorized to submit same. I hereby certify that the Respondent has reviewed all documents and requirements included in this offer and accept its terms and conditions.

Terms: _____ Fed. ID #: _____

Company (Respondent): _____

Address: _____

_____

City, State & Zip Code: _____

Phone / Fax Number: _____ FAX: _____

Email: _____

Print Name and Title: _____

(Authorized Representative)

Signed: _____

(Authorized Representative)

EXHIBIT B - QUALIFICATIONS AND LICENSES REQUIREMENTS

Please give a synopsis of your qualifications and experience with this service:

Please list Licenses:

How long have you been in business?

Have you done business with the City of Flint?

If yes, please state the project name.

EXHIBIT C – DISCLOSURE OF SUPPLIER RESPONSIBILITY STATEMENT

1. List any convictions of any person, subsidiary, or affiliate of the company, arising out of obtaining, or attempting to obtain a public or private contract, or subcontract, or in the performance of such contract or subcontract.

2. List any convictions of any person, subsidiary, or affiliate of this company for offenses such as embezzlement, theft, fraudulent schemes, etc. or any other offense indicating a lack of business integrity or business honesty which affect the responsibility of the contractor.

3. List any convictions or civil judgments under state or federal antitrust statutes.

4. List any violations of contract provisions such as knowingly (without good cause) to perform, or unsatisfactory performance, in accordance with the specifications of a contract.

5. List any prior suspensions or debarments by any government agency.

6. List any contracts not completed on time.

7. List any documented violations of federal or state labor laws, regulations or standards, or occupational safety and health rules.

❖ EXHIBIT D – LIST OF REFERENCES: (3) SIMILAR SCOPE OF WORK FROM THE LAST 5 YEARS

Providing the following contact information enables the City of Flint to contact those accounts as references.

Reference #1:

Company/Municipality: _____

Contact Person: _____ Title: _____

Address: _____

City: _____ State: _____ Zip: _____

Telephone: _____ Fax: _____

Email: _____

Type of Project: _____

_____

Project Timeline (Dates): _____ Budget: _____

Reference #2:

Company/Municipality: _____

Contact Person: _____ Title: _____

Address: _____

City: _____ State: _____ Zip: _____

Telephone: _____ Fax: _____

Email: _____

Type of Project: _____

_____

Project Timeline (Dates): _____ Budget: _____

❖ EXHIBIT D – LIST OF REFERENCES: (3) SIMILAR SCOPE OF WORK FROM THE LAST 5 YEARS (CONTINUES)

Reference #3:

Company/Municipality: _____

Contact Person: _____ Title: _____

Address: _____

City: _____ State: _____ Zip: _____

Telephone: _____ Fax: _____

Email: _____

Type of Project: _____

_____

Project Timeline (Dates): _____ Budget: _____

❖ EXHIBIT E – CERTIFICATE OF INSURANCE

INSURANCE REQUIREMENTS

The Contractor shall notify all insurance agents and companies retained by the Contractor that these insurance requirements shall be included in any Agreement between the Contractor and the City of Flint.

The Contractor shall purchase and maintain, at its sole expense and as long as it is providing services to the City, the following insurance coverage:

Commercial General Liability - Occurrence form, including coverage for bodily injury, personal injury, property damage (broad form), premises/operations, blanket contractual, and products/completed operations. Coverage shall be endorsed to include the City as an additional insured for work performed by the Contractor in accordance with the Agreement.

Minimum Limits:

- $1,000,000 per occurrence/$2,000,000 general aggregate
- $2,000,000 aggregate for products and completed operations
- $1,000,000 personal and advertising injury

Automobile - Michigan "no-fault" coverage, and residual automobile liability, comprehensive form, covering owned, hired, and non-owned automobiles. Coverage shall be endorsed to include the City as an additional insured for work performed by the Contractor in accordance with the Agreement.

Minimum Limits:

- No-fault coverages - statutory
- $500,000 per person/$1,000,000 per accident - bodily injury
- $500,000 per occurrence - property damage
- A combined single limit of $1,000,000 per occurrence

Workers' Compensation and Employer's Liability- Statutory coverage or proof acceptable to the City of approval as a self-insurer by the State of Michigan.

❖ EXHIBIT E – CERTIFICATE OF INSURANCE (CONTINUES)

Minimum Limits:

- Workers' Compensation - statutory
- Employer's Liability - $100,000 each accident/$100,000 disease - each employee
- $500,000 disease - policy limit

Professional Liability – Covering acts, errors or omissions of a professional nature committed or alleged to have been committed by the Contractor or any of its subcontractors. Coverage shall be effective upon the date of the Agreement and shall remain effective for a period of three (3) years after the date of final payment thereunder. Such coverage shall be endorsed to include any subcontractors hired by the City.

Minimum Limits:

- $1,000,000 per occurrence, $1,000,000 annual aggregate

Insurance coverage shall cover all claims against the City of Flint, its officials and employees, arising out of the work performed by the Contractor or any subcontractors under the Agreement. Should any work be subcontracted, it shall be the responsibility of the Contractor to maintain Independent Contractor's Protective Liability Insurance with limits equal to those specified above for Commercial General Liability Insurance. In addition, the Contractor shall provide proof of Workers' Compensation Insurance for all subcontractors in compliance with the required statutory limits of the State of Michigan.

Said policies of insurance shall be with companies licensed to do business in the State of Michigan and in a form satisfactory to the City. All insurance companies must maintain a rating of B+, VIII or better from AM. Best Company. Certificates of insurance with a thirty-(30) day cancellation clause shall be filed with and approved by the City at least five (5) days in advance of commencing work under the Agreement. Cancellation, material restriction, non-renewal or lapse of any of the required policies shall be grounds for immediate termination of the Agreement by the City.

The City reserves the right to request a complete certified copy of the policies for the above coverage's.

Any reduction or exhaustion in the limits of required insurance coverage shall not be deemed to limit the indemnification afforded in accordance with the Agreement or any amendments thereto.

Depending on the subject matter of the transaction, the City may require other insurance coverage in addition to the coverage's contained herein.

THE BID NUMBER IS TO APPEAR ON ALL INSURANCE CERTIFICATES

❖ EXHIBIT F – NON-BIDDER'S RESPONSE

VENDOR'S NAME: _____

NON-BIDDER'SRESPONSE

For the purpose of facilitating your firm's response to our invitation to bid, the City of Flint is interested in ascertaining reasons for prospective bidder's failure to respond to "Invitations to Bid". If your firm is not responding to this bid, please indicate the reason(s) by checking any appropriate item(s) below and return this form to the above address.

We are ***not*** responding to this "Invitation to Bid" for the following reason(s):

_____ Items or materials requested not manufactured by us or not available to our company.

_____ Our items and/or materials do not meet specifications.

_____ Specifications not clearly understood or applicable (too vague, too rigid, etc.).

_____ Quantities too Small.

_____ Insufficient time allowed for preparation of bid.

_____ Incorrect address used. Our correct mailing address is:

_____

_____ Our branch / division handles this type of bid. We have forwarded this bid on to them but for the future the correct name and mailing address is:_____

_____ **OTHER:** _____

_____

Thank you for your participation in this bid.

❖ EXHIBIT G – CITY OF FLINT AFFADAVIT

AFFIDAVIT FOR INDIVIDUAL

STATE OF _____

S.S.

COUNTY OF _____

_____being duly sworn, deposes and says that they are the person making the above bid; and that said bid is genuine and not sham or collusive, and is not made in the interest of or on behalf of any person not therein named, and that they have not directly or indirectly induced or solicited any bidder to put in a sham bid; that they have not directly or indirectly induced or solicited any other person or corporation to refrain from bidding, and that they have not in any manner sought by collusion to secure themselves any advantage over other bidders.

Subscribed and sworn to before me at _____, in said County and State,

this _____day of _____, A.D. 20_____,

_____

*Notary Public, _____County,_____

My Commission expires_____,20_____

❖ EXHIBIT G – CITY OF FLINT AFFADAVIT

FOR CORPORATION

STATE OF _____

S.S.

COUNTY OF _____

_____being duly sworn, deposes and says that she/he/they

is_____of_____

(Official Title) (Name of Corporation)

a corporation duly organized and doing business under the laws of the State of _____ the corporation making the within and foregoing bid; that they executed said bid in behalf of said corporation by authority of its Board of Directors; that said bid is genuine and not sham or collusive and is not made in the interests of or on behalf of any person not herein named, and that they have not and said bidder has not directly or indirectly induced or solicited any other person or corporation to refrain from bidding; that they have not and said bidder has not in any manner sought by collusion to secure to themselves or to said corporation an advantage over other bidders.

Subscribed and sworn to before me at _____, in said County and State,

this _____day of _____, A.D. 20_____,

_____

*Notary Public, _____County,_____

My Commission expires_____,20_____

CONTENTS

[1] Division 3 specifications are in 6-digit MasterFormat
[2] Division 5 specifications are in 6-digit MasterFormat

[3] Division 23 specifications are in 6-digit MasterFormat

SECTION 01110 - SUMMARY OF WORK

PART 1 - GENERAL

1.01 SUMMARY

A. The Project is located at City of Flint Lift Station 5, 2420 Brownell, Flint, MI 48504.

B. The Work consists of the reconstruction of Lift Station 5 for the City of Flint. The work includes demolition of the existing building and replacement of the building, including replacement of the existing electrical and HVAC equipment.

1.02 GENERAL CONSTRAINTS AND WORK SEQUENCE

A. CONTRACTOR shall arrange its Work so that at no time shall it cause unnecessary interruption to the operation of existing facilities. General constraints and temporary facility requirements that the CONTRACTOR shall incorporate in the Project schedule and sequence of construction are outlined below. Note that this listing is not represented as comprehensive or complete. Additional accommodation to facilitate operation and other temporary facilities shall also be required to complete the work.

B. Suggested Sequence of Construction
   a. The existing lift station shall remain in continuous operation. Temporary power shall be furnished and installed to power the pumps and existing control panel prior to commencing demolition activities.

C. If CONTRACTOR wishes to propose an alternate sequence of construction for maintaining operation of existing facilities, CONTRACTOR shall submit complete details of its plan to ENGINEER for approval.

D. General Constraints
   1. Operation of Lift Station 5 shall be maintained at all times.
   2. No interruption of service at the lift station shall occur without the expressed prior approval of the OWNER and Engineer. Bypass pumping will be required for any temporary shutdown of the lift station and CONTRACTOR shall provide a bypass pumping plan if any bypass pumping is required.

1.03 CONTRACTOR USE OF PREMISES

A. Limit use of the premises to construction activities in areas indicated; allow for OWNER occupancy and use by the public. Confine operations to areas within Contract limits indicated. Portions of the Site beyond areas in which construction operations are indicated are not to be disturbed.

B. Keep driveways and entrances serving the premises clear and available to OWNER, OWNER's employees, and private property owners at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on Site. Areas for CONTRACTOR's trailers, equipment, and material storage, and CONTRACTOR's employee parking shall be as indicated on Drawings or agreed by OWNER prior to the start of construction.

1.04 OWNER OCCUPANCY

A. Full OWNER Occupancy: OWNER will occupy the Site during the entire construction period. Cooperate with OWNER during construction operations to minimize conflicts and facilitate OWNER usage. Perform the Work so as not to interfere with OWNER's operations.

1.05 MISCELLANEOUS PROVISIONS

A. CONTRACTOR shall notify MISS DIG-Utility Communication System, 1-800-482-7171, three working days prior to starting any excavation with power equipment.

B. CONTRACTOR shall be responsible for verifying the location of all underground utilities by magnetic or other type instruments before beginning excavation Work.

C. Time and Sequence of Work: In general, it is the intention and understanding that CONTRACTOR shall have control over the sequence or order of execution of the several parts of the Work to be done under the Contract and over the method of accomplishing the required results, except as some particular sequence or method may be distinctly demanded by the Drawings and Project Manual or by the expressed provisions of the Contract. ENGINEER may, however, make such reasonable requirements as may, in ENGINEER's judgment, be necessary for the proper and effective protection of Work partially or wholly completed, and to these requirements CONTRACTOR shall conform.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 01230 - ALTERNATES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements for Alternates.

1.02 DEFINITIONS

A. Alternate: An amount proposed by Bidders and stated on Bid Form for certain construction activities defined in the Bidding Requirements that may be added to or deducted from Base Bid amount if OWNER decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1.03 OWNER'S INSTRUCTIONS

A. Coordinate related Work and modify or adjust adjacent Work as necessary to ensure that Work affected by each accepted Alternate is complete and fully integrated into the Project.

B. OWNER will evaluate Bids from the Base Lump Sum Bid price, and add or deduct the amounts stated on Bid Form for the Alternate in the order in which the Alternates are listed on Schedule at the end of this Section. OWNER reserves the right to determine how many Alternates will be added or deducted for this Project. The cost of the Alternate shall include any appropriate amounts for general conditions, bonds, insurances, materials, labor, tools, power, transportation, construction equipment, and associated items involved with the described Alternate.

C. Immediately following the award of the Contract, prepare and distribute to each party involved, notification of the status of each Alternate. Indicate whether Alternates have been accepted, rejected, or deferred for consideration at a later date. Include a complete description of negotiated modifications to Alternates.

D. A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced on the Schedule contain requirements for materials and methods necessary to achieve the Work described under each Alternate. Drawings referenced on the Schedule indicate the Work required to perform the Alternate.

E. Include as part of each Alternate, miscellaneous devices, accessory objects, and similar items that are included with or required for a complete installation, whether or not mentioned as part of the Alternate.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

SCHEDULE OF ALTERNATES

Alternates to the Base Bid Form are offered as follows:

Alternate No. 1

Description: Provide furnish and install protective bollards and boulders as shown on A-104 – Exterior Building Protection Plan.

Reference Drawing No. A-104.

END OF SECTION

SECTION 01290 - APPLICATIONS FOR PAYMENT

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements governing CONTRACTOR's Applications for Payment.

B. Related Sections:
   1. CONTRACTOR's Application for Payment form is included in Section 00620.
   2. CONTRACTOR's Construction Schedule and Submittal Schedule are included in Section 01330.

1.02 OWNER'S INSTRUCTIONS

A. Schedule of Values:
   1. Coordinate preparation of Schedule of Values with preparation of CONTRACTOR's Construction Schedule.
   2. Correlate line items on Schedule of Values with other required administrative schedules and forms, including:
      a. CONTRACTOR's Construction Schedule.
      b. Application for Payment form.
      c. List of subcontractors.
      d. Schedule of Allowances.
      e. Schedule of Alternates.
      f. List of products.
      g. List of principal suppliers and fabricators.
      h. Schedule of Submittals.
   3. Submit Schedule of Values to ENGINEER at the earliest feasible date, but in no case later than 7 days before the date scheduled for submittal of the initial Application for Payment.
   4. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for Schedule of Values.
   5. Identification: Include the following Project identification on Schedule of Values:
      a. Project name and location.
      b. Name of ENGINEER.
      c. Project number.
      d. CONTRACTOR's name and address.
      e. Date of submittal.
   6. Arrange Schedule of Values in a tabular form with separate rows for each Specification Section and separate columns for each major structure or area of Work.
   7. Provide a breakdown of the Contract Price in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.
   8. Round off amounts to the nearest whole dollar; the total shall equal the Contract Price.
   9. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

10. Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually on Applications for Payment. Each item on Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.
11. At CONTRACTOR's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items on Schedule of Values or distributed as general overhead expense.
12. Update and resubmit Schedule of Values when Change Orders or Work Change Directives result in a change in the Contract Price.

B. Initial Application for Payment: Administrative actions and submittals that must precede submittal of the first Application for Payment include the following:
1. List of subcontractors.
2. List of principal suppliers and fabricators.
3. Schedule of Values.
4. CONTRACTOR's Construction Schedule (preliminary if not final).
5. Schedule of principal products.
6. Schedule of unit prices.
7. Submittal Schedule (preliminary if not final).

C. Applications For Payment:
1. Work, installation, equipment, etc. will not be paid past 90% complete until work, installation, equipment has been started, fully functional, and passed all performance tests to the satisfaction of the Engineer. This includes payment for stored equipment.
2. The OWNER shall pay up to 70 percent on equipment and material that has been delivered to the site but is not yet installed. Items shall be properly stored and maintained per manufacturuer guidelines.
3. Each Application for Payment shall be consistent with previous applications and payments as certified by ENGINEER and paid for by OWNER.
4. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.
5. The date for each progress payment will be determined at the Pre-Construction Conference. The period of construction Work covered by each Application for Payment is 1 month. Actual start/end dates will be determined at the Pre-Construction Conference.
6. Use the pay application form included in Section 00620 for Applications for Payment.
7. Complete every entry on the form, including execution by person authorized to sign legal documents on behalf of CONTRACTOR. Incomplete applications will be returned without action.
8. Entries shall match data on Schedule of Values and CONTRACTOR's Construction Schedule. Use updated Schedules if revisions have been made.
9. Include amounts of Change Orders and Work Change Directives issued prior to the last day of the construction period covered by the application.
10. Submit 3 executed copies of each Application for Payment to ENGINEER; 1 copy shall be complete, including waivers of lien and similar attachments, when required.
11. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to ENGINEER.

D. Application for Payment at Substantial Completion:
1. Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for OWNER occupancy of designated portions of the Work.

2. Administrative actions and submittals that shall proceed or coincide with this application include:
    a. Occupancy permits and similar approvals.
    b. Warranties (guarantees) and maintenance agreements.
    c. Test/adjust/balance records.
    d. Maintenance instructions.
    e. Meter readings.
    f. Start-up performance reports.
    g. Changeover information related to OWNER's occupancy, use, operation, and maintenance.
    h. Final cleaning.
    i. Application for reduction of retainage and consent of surety.
    j. Advice on shifting insurance coverages.
    k. Final progress photographs.
    l. List of incomplete Work, recognized as exceptions to ENGINEER'S Certificate of Substantial Completion.

E. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:
    1. Completion of Project closeout requirements.
    2. Completion of items specified for completion after Substantial Completion.
    3. Assurance that unsettled claims will be settled.
    4. Assurance that Work not complete and accepted will be completed without undue delay.
    5. Transmittal of required Project construction records to OWNER.
    6. Proof that taxes, fees, and similar obligations have been paid.
    7. Removal of temporary facilities and services.
    8. Removal of surplus materials, rubbish, and similar elements.
    9. Change of door locks to OWNER's access.
    10. CONTRACTOR's waivers of mechanics liens for Project.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 01310 - PROJECT COORDINATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:
   1. Coordination of Work under this Contract.
   2. Coordination with other Contractors.
   3. Administrative and supervisory personnel.
   4. Land survey work.
   5. Pre-Construction Conference.
   6. Pre-Installation Conference.
   7. Progress meetings.
   8. General installation provisions.
   9. Cleaning and protection.

B. Related Sections Specified Elsewhere:
   1. Equipment installation check, and operation, maintenance, and training of OWNER's personnel are included in Section 01600 and Sections for specific equipment items.
   2. Requirements for CONTRACTOR's Construction Schedule are included in Section 01330.

1.02 SUBMITTALS

A. At the Preconstruction Meeting, submit to the OWNER a list of CONTRACTOR's principal staff assignments, including the Superintendent and other personnel in attendance at Site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.

1.03 SCHEDULING

A. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair. Make adequate provisions to accommodate items scheduled for later installation.

B. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at Site in accordance with Laws or Regulations. CONTRACTOR shall train CONTRACTOR's employees on use of these sheets and shall keep a master copy on hand at Site.

C. Coordination with Other Contractors:
   1. CONTRACTOR shall so conduct CONTRACTOR's operations as not to interfere with or injure the Work of other Contractors or workmen employed on adjoining or related Work, and CONTRACTOR shall promptly make good any injury or damage which may be done to such Work by CONTRACTOR or CONTRACTOR's employees or agents.

2. Should a contract for adjoining Work be awarded to another CONTRACTOR, and should the Work on one of these contracts interfere with that of the other, ENGINEER shall decide which contract shall cease Work for the time being and which shall continue, or whether Work on both contracts shall continue at the same time and in what manner.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of schedules.
   2. Installation and removal of temporary facilities.
   3. Delivery and processing of submittals.
   4. Progress meetings.
   5. Project closeout activities.

1.04 PRE-CONSTRUCTION CONFERENCE

A. Within 10 days of Notice of Award, ENGINEER will schedule a Pre-Construction Conference and organizational meeting at the Site or other convenient location prior to commencement of construction activities to review responsibilities and personnel assignments.

B. Attendees: OWNER, ENGINEER and ENGINEER's consultants, CONTRACTOR and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could affect progress including such topics as:
   1. Tentative Construction Schedule.
   2. Critical Work sequencing.
   3. Designation of responsible personnel.
   4. Procedures for processing field decisions and Change Orders.
   5. Procedures for processing Applications for Payment.
   6. Distribution of Contract Documents.
   7. Submittal of Shop Drawings, product data, and samples.
   8. Preparation of Record Documents.
   9. Use of the premises.
   10. Office, Work, and storage areas.
   11. Equipment deliveries and priorities.
   12. Safety procedures.
   13. First aid.
   14. Security.
   15. Housekeeping.
   16. Working hours.

1.05 PRE-INSTALLATION CONFERENCE

A. Where specified, CONTRACTOR, supplier, and ENGINEER shall meet on Site and discuss tools, techniques, and procedures for installation of products and equipment prior to performing the Work.

1.06 PROGRESS MEETINGS

A. Progress Meeting will take place on a monthly basis.

B. Attendees: In addition to representatives of OWNER and ENGINEER, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.

D. CONTRACTOR's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to CONTRACTOR's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

E. Reporting: CONTRACTOR will prepare and distribute copies of minutes of the meeting to each party present and to other parties who should have been present. The minutes will include a brief summary, in narrative form, of progress since the previous meeting and report.

F. Schedule Updating: CONTRACTOR shall revise Construction Schedule after each progress meeting where revisions to Schedule have been made or recognized. Issue revised Schedule no later than 3 days after the progress meeting date to ENGINEER for distribution concurrently with the progress meeting minutes.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 LAND SURVEY WORK

A. CONTRACTOR Performance:
   1. Verify layout information shown on Drawings, in relation to the property survey and existing benchmarks before proceeding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
      a. Record benchmark locations, with horizontal and vertical data, on Contract Record Documents.
   2. Working from lines and levels established by ENGINEER, establish benchmarks and markers to set lines and levels at each area of Work and elsewhere as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.
   3. Benchmarks or control points shall not be changed or relocated without prior written approval by ENGINEER. Promptly report lost or destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations.
   4. Promptly replace lost or destroyed Project control points. Base replacements on the original survey control points.

5. Advise entities engaged in construction activities, of marked lines and levels provided for their use.
6. As construction proceeds, check every major element for line, level and plumb.
7. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes, and invert elevations by instrumentation and similar appropriate means.
8. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels, and control lines and levels required for mechanical and electrical Work.
9. Existing Utilities and Equipment:
    a. The existence and location of underground and other utilities and construction as shown on Drawings as existing are not guaranteed. Before beginning Site Work, CONTRACTOR shall investigate and verify the existence and location of underground utilities and other construction.
    b. Furnish information necessary to adjust, move, or relocate existing structures, utility poles, lines, services, or other appurtenances located in or affected by construction. Coordinate with local authorities having jurisdiction.
    c. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping.

3.02 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

END OF SECTION

SECTION 01330 - SUBMITTALS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements for submittals, including, but not necessarily limited to, the following:
   1. CONTRACTOR's Construction Schedule.
   2. Submittal Schedule.
   3. Shop Drawings.
   4. Product data.
   5. Samples.
   6. Progress photographs.
   7. Record photographs.

B. Topics covered elsewhere include, but are not limited to:
   1. Permits.
   2. Applications for payment.
   3. Performance and payment bonds.
   4. Insurance certificates.
   5. List of subcontractors.

1.02 SUBMITTALS

A. Bonds and Insurance Certificates shall be submitted to and approved by OWNER and ENGINEER prior to the initiation of any construction on Site.

B. Permits, Licenses, and Certificates: For OWNER's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents; correspondence and records established in conjunction with compliance with standards; and regulations bearing upon performance of the Work.

1.03 SUBMITTAL PROCEDURES

A. Coordination:
   1. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
   2. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   3. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
   4. ENGINEER reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Processing:
   1. Allow sufficient review time so that installation shall not be delayed as a result of the time required to process submittals, including time for resubmittals.

2. ENGINEER will review and return submittals with reasonable promptness, or advise CONTRACTOR when a submittal being processed must be delayed for coordination or receipt of additional information by putting the submittal "On Hold" and returning a transmittal identifying the reasons for the delay.
3. No extension of Contract Time will be authorized because of failure to transmit submittals to ENGINEER sufficiently in advance of the Work to permit processing.

C. Submittal Preparation:
1. Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
2. Provide a space approximately 4 inches by 5 inches on the label or beside the title block on submittals not originating from CONTRACTOR to record CONTRACTOR's review and approval markings and the action taken.
3. Include the following information on the label for processing and recording action taken.
   a. Project name.
   b. Date.
   c. Name and address of ENGINEER.
   d. Name and address of CONTRACTOR.
   e. Name and address of subcontractor.
   f. Name and address of supplier.
   g. Name of manufacturer.
   h. Number and title of appropriate Specification Section.
   i. Drawing number and detail references, as appropriate.
4. Any markings done by CONTRACTOR shall be done in green or blue. Red and yellow highlight are reserved for ENGINEER's marking.
5. The number of copies to be submitted will be determined at the pre-construction conference. Reproducibles may be submitted and will be marked and returned to CONTRACTOR. Blue or black line prints shall be submitted in sufficient quantity for distribution to ENGINEER and OWNER recipients.
6. At completion of the project, CONTRACTOR to provide one CD that includes all submittals, O&M manuals, construction photos, start-up reports, and record drawings.

D. Submittal Transmittal:
1. Package each submittal appropriately for shipping and handling. This shall include an index either on the transmittal or within the submittal itself. Transmit each submittal from CONTRACTOR to ENGINEER using a transmittal form. Submittals received from sources other than CONTRACTOR will be returned without action. Use separate transmittals for items from different specification sections. Number each submittal consecutively. Resubmittals should have the same number as the original, plus a letter designation for each resubmittal (i.e., 7-A, 7-B, etc.).
2. Indicate on the transmittal relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include CONTRACTOR's certification that information complies with Contract Document requirements. On resubmittal, all changes shall be clearly identified for ease of review. Resubmittals shall be reviewed for the clearly identified changes only. Any changes not clearly identified will not be reviewed and original submittal shall govern.

1.04 CONSTRUCTION SCHEDULE

A. Bar Chart Schedule:
   1. Prepare a fully developed, horizontal bar chart type Construction Schedule. Submit within 30 days of the date established for "NOTICE TO PROCEED."
   2. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated on Schedule of Values.
   3. Prepare Schedule on a sheet, or series of sheets, of stable transparency or other reproducible media, of sufficient width to show data for the entire construction period.
   4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on Schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
   5. Coordinate Construction Schedule with Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other schedules.
   6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on Schedule to allow time for ENGINEER's procedures necessary for certification of Substantial Completion.

B. Schedule Updating: Revise Schedule after each meeting or activity where revisions have been recognized or made within 2 weeks following the meeting or activity.

1.05 SUBMITTAL SCHEDULE

A. After development and acceptance of Construction Schedule, prepare a complete Schedule of Submittals. Submit Schedule within 10 days of the date required for establishment of Construction Schedule.

B. Coordinate Submittal Schedule with the list of subcontracts, Schedule of Values, and the list of products, as well as Construction Schedule.

C. Prepare Schedule in chronological order; include submittals required during the first 90 days of construction. Provide the following information:
   1. Scheduled date for the first submittal.
   2. Related Section number.
   3. Submittal category.
   4. Name of subcontractor.
   5. Description of the part of the Work covered.
   6. Scheduled date for resubmittal.
   7. Scheduled date ENGINEER's final release or approval.

D. Following response to initial submittal, print and distribute copies to ENGINEER, OWNER, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the Project meeting room and field office.

E. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

F. Schedule Updating: Revise Schedule after each meeting or activity where revisions have been recognized or made within 2 weeks following the meeting or activity.

1.06 SHOP DRAWINGS

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. Include the following information:
   1. Dimensions.
   2. Identification of products and materials included.
   3. Compliance with specified standards.
   4. Notation of coordination requirements.
   5. Notation of dimensions established by field measurement.

C. Nameplate data for equipment including electric motors shall be included on Shop Drawings. Electric motor data shall state the manufacturer, horsepower, service factor, voltage, enclosure type, oversize wiring box, etc.

D. Shop Drawings shall indicate shop painting requirements to include type of paint and manufacturer.

E. Standard manufactured items in the form of catalog work sheets showing illustrated cuts of the items to be furnished, scale details, sizes, dimensions, quantity, and all other pertinent information should be submitted and approved in a similar manner.

F. Measurements given on Shop Drawings or standard catalog sheets, as established from Contract Drawings and as approved by ENGINEER, shall be followed. When it is necessary to verify field measurements, they shall be checked and established by CONTRACTOR. The field measurements so established shall be followed by CONTRACTOR and by all affected trades.

G. Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 inches by 11 inches but no larger than 36 inches by 48 inches.

H. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

1.07 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as Shop Drawings.

B. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
   1. Manufacturer's printed recommendations.

2. Compliance with recognized trade association standards.
3. Compliance with recognized testing agency standards.
4. Application of testing agency labels and seals.
5. Notation of dimensions verified by field measurement.
6. Notation of coordination requirements.

C. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

1.08 SAMPLES

A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

B. Mount, display, or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match ENGINEER's Sample. Include the following:
1. Generic description of the Sample.
2. Sample source.
3. Product name or name of manufacturer.
4. Compliance with recognized standards.
5. Availability and delivery time.

C. Submit Samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

D. Where variation in color, pattern, texture, or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3) that show approximate limits of the variations.

E. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

F. Preliminary Submittals: Where Samples are for selection of color, pattern, texture, or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.
1. Preliminary submittals will be reviewed and returned with ENGINEER's mark indicating selection and other action.

G. Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 3 sets; 1 will be returned marked with the action taken.

H. Maintain sets of Samples, as returned, at the Site, for quality comparisons throughout the course of construction.

I. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

J. Sample sets may be used to obtain final acceptance of the construction associated with each set.

1.09 ENGINEER'S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, ENGINEER will review each submittal, mark to indicate action taken, and return promptly.
   1. Compliance with specified characteristics is CONTRACTOR's responsibility.

B. Action Stamp: ENGINEER will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:
   1. Final Unrestricted Release: Where submittals are marked "No Exceptions Taken," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
   2. Final-But-Restricted Release: When submittals are marked "Furnish as Corrected," that part of the Work covered by the submittal may proceed, provided it complies with notation or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
   3. Returned for Resubmittal: When submittal is marked "Rejected" or "Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
      a. Do not permit submittals marked "Rejected" or "Revise and Resubmit" to be used at Site, or elsewhere where Work is in progress.
   4. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Acknowledge Receipt."
   5. The approval of ENGINEER shall not relieve CONTRACTOR of responsibility for errors on Drawings or submittals as ENGINEER's checking is intended to cover compliance with Drawings and Specifications and not enter into every detail of the shop work.

1.10 PROGRESS PHOTOGRAPHS

A. During the process of the Work, photographs shall be taken at the rate of at least 4 every month from start of construction until acceptance by OWNER. These photographs shall be taken from points and at the times directed by ENGINEER.

B. Digital files in high resolution JPEG format and of adequate quality to reproduce prints of approximately 7-1/2 x 9-1/2 inches overall, shall be provided to ENGINEER and OWNER. However, the requirement for numbers of prints and binding shall remain unchanged. At the conclusion of the Work, the digital files shall become the property of the OWNER.
   1. Upon completion of the Work, the digital photos shall be copied to two CD’s and shall be turned over to the OWNER.

1.11 RECORD PHOTOGRAPHS

A. After final acceptance of the Work, 24 photographs shall be taken of each structure and major feature of the Project as directed by ENGINEER. These photographs shall be taken from points and at times directed by ENGINEER.

B. Two CDs containing all record photos shall be turned over to the OWNER at the completion of the Work.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 01420 - DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.01 DEFINITIONS

A. Basic Contract definitions are included in the General Conditions.

B. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.02 INDUSTRY STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference. Individual Sections indicate which codes and standards CONTRACTOR must keep available at Site for reference.

B. Updated Standards: At the request of ENGINEER, CONTRACTOR, or authority having jurisdiction, submit a Change Order proposal where an applicable code or standard has been revised and reissued after the date of the Contract Documents and before performance of Work affected. ENGINEER will decide whether to issue a Change Order to proceed with the updated standard.

C. Minimum Quantity or Quality Levels: In every instance the quantity or quality level shown or specified shall be the minimum to be provided or performed. The actual installation may comply exactly, within specified tolerances, with the minimum quantity or quality specified, or it may exceed that minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum values, as noted, or appropriate for the context of the requirements. Refer instances of uncertainty to ENGINEER for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed for performance of a required construction activity, CONTRACTOR shall obtain copies directly from the publication source.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The following acronyms or abbreviations as referenced in Contract Documents are defined to mean the associated names. Names and addresses are subject to change and are believed to be, but are not assured to be, accurate and up to date as of date of Contract Documents.

AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol St., NW, Suite 249; Washington, D.C. 20001
ACI	American Concrete Institute P.O. Box 9094; Farmington Hills, MI 48333-9094

ACPA	American Concrete Pipe Association 222 West Las Colinas Blvd., Suite 641; Irving, TX 75039-5423
AGA	American Gas Association 400 N Capitol St., NW; Washington, D.C. 20001
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute Research Park Dr., P.O. Box 14052; Lexington, KY 40512-4052
A.I.A.	American Insurance Association 1130 Connecticut Ave., NW, Suite 1000; Washington, D.C. 20036
AISC	American Institute of Steel Construction One East Wacker Dr., Suite 3100; Chicago, IL 60601-2001
AISI	American Iron and Steel Institute 1101 Seventeenth St., NW; Washington, D.C. 20036
ALI	Associated Laboratories, Inc. P.O. Box 152837; Dallas, TX 75315
ANSI	American National Standards Institute 25 West 43rd St.; New York, NY 10036
ASCE	American Society of Civil Engineers 1801 Alexander Bell Dr.; Reston, VA 20191-4400
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers 1791 Tullie Circle, NE; Atlanta, GA 30329
ASME	American Society of Mechanical Engineers 345 East 47th St.; New York, NY 10017
ASSE	American Society of Safety Engineers 1800 East Oakton Street, Des Plaines, IL 60018
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr.; West Conshohocken, PA 19428-2959
AWS	American Welding Society 550 NW Le Jeune Rd.; Miami, FL 33126
AWWA	American Water Works Association 6666 W. Quincy Ave.; Denver, CO 80235
CRSI	Concrete Reinforcing Steel Institute 933 North Plum Grove Rd.; Schaumburg, IL 60173

CSA	Canadian Standards Association
FM	Factory Mutual Engineering and Research 1151 Boston-Providence Turnpike; Norwood, MA 02062-9102
H.I.	Hydraulic Institute 9 Sylvan Way; Parsippany, NJ 07054
IEEE	Institute of Electrical and Electronic Engineers 3 Park Ave., 17th Floor; New York, NY 10016-5997
ISA	Instrument Society of America 67 Alexander Dr.; Research Triangle Park, NC 27709
MBMA	Metal Building Manufacturers Association 1300 Summer Ave.; Cleveland, OH 44115-2851
NAPA	National Asphalt Pavement Association 5100 Forbes Blvd.; Lanham, MD 20706-4413
NCPI	National Clay Pipe Institute P.O. Box 759; Lake Geneva, WI 53147
NEC	National Electrical Code (by NFPA)
NESC	National Electrical Safety Code
NEMA	National Electrical Manufacturers Association 1300 North 17th St., Suite 1847; Rosslyn, VA 22209
NFPA	National Fire Protection Association 1 Batterymarch Park; Quincy, MA 02269-9101
NPCA	National Precast Concrete Association 10333 North Meridian St., Suite 272; Indianapolis, IN 46290
PCA	Portland Cement Association 5420 Old Orchard Rd.; Skokie, IL 60077-1083
PCI	Precast/Prestressed Concrete Institute 209 W. Jackson Blvd.; Chicago, IL 60606-6938
PDI	Plumbing and Drainage Institute 800 Turnpike Street, Suite 300, North Andover, MA 01845
PTI	Post-Tensioning Institute 1717 W. Northern Ave., Suite 114; Phoenix, AZ 85021
SDI	Steel Deck Institute P.O. Box 25; Fox River Grove, IL 60021-0025

SJI Steel Joist Institute
3127 10th Ave. North Ext.; Myrtle Beach, SC 29577-6760

SMACNA Sheet Metal & Air Conditioning
Contractors' National Association
4201 Lafayette Center Dr.; Chantilly, VA 20151-1209

SSPC The Society for Protective Coatings
40 24th St., 6th Floor; Pittsburgh, PA 15222-4565

TPI Truss Plate Institute
583 Donofrio Dr., Suite 200; Madison, WI 53719

UL Underwriters Laboratories
333 Pfingsten Rd.; Northbrook, IL 60062-2096

F. Government Agencies. Names and titles of state and Federal Government standard or Specification producing agencies are frequently abbreviated. The following acronyms or abbreviations referenced in the Contract Documents indicate names of standard or Specification producing agencies of the Federal government. Names and addresses are subject to change but are believed to be, but are not assured to be, accurate and up to date as of the date of the Contract Documents.

CE Corps of Engineers
(U.S. Department of the Army)
Chief of Engineers - Referral
Washington, D.C. 20314

CFR Code of Federal Regulations
(Available from the Government Printing Office)
N. Capitol Street between G and H St. NW
Washington, D.C. 20402
(Material is usually first published in the Federal Register)

DOT Department of Transportation
400 Seventh Street, SW
Washington, D.C. 20590

EDA Economic Development Administration
U.S. Department of Commerce
121 N. Canal Street, Suite 855
Chicago, IL 60606

EGLE Michigan Department of Environment, Great Lakes, and Energy

EPA Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

MDOT Michigan Department of Transportation

MIOSHA State of Michigan OSHA

OSHA Occupational Safety and Health Administration
(U.S. Department of Labor)
Government Printing Office
Washington, D.C. 20402

1.03 GOVERNING REGULATIONS/AUTHORITIES

A. ENGINEER has contacted authorities having jurisdiction where necessary to obtain information necessary for the preparation of Contract Documents; that information may or may not be of significance to CONTRACTOR. Contact authorities having jurisdiction directly for information and decisions having a bearing on the Work.

1.04 SUBMITTALS

A. Permits, Licenses, and Certificates: For OWNER's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 01450 - QUALITY CONTROL SERVICES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements for quality control services.

B. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and CONTRACTOR. They do not include Contract enforcement activities performed by ENGINEER.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve CONTRACTOR of responsibility for compliance with Contract Document requirements.

D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.

E. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.

F. Inspections, tests, and related actions specified are not intended to limit CONTRACTOR's quality control procedures that facilitate compliance with Contract Document requirements.

G. Requirements for CONTRACTOR to provide quality control services required by ENGINEER, OWNER, or authorities having jurisdiction are not limited by provisions of this Section.

1.02 CONTRACTOR RESPONSIBILITIES

A. Provide inspections, tests, and similar quality control services, specified in individual Specification Sections and required by governing authorities, except where they are specifically indicated to be OWNER's responsibility, or are provided by another identified entity; these services include those specified to be performed by an independent agency and not by CONTRACTOR. Costs for these services shall be included in the Contract Price.

B. Employ and pay an independent agency to perform specified quality control services.

C. CONTRACTOR and each agency engaged to perform inspections, tests, and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition, CONTRACTOR and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

D. Schedule times for inspections, tests, taking samples, and similar activities.

E. Retesting: CONTRACTOR is responsible for retesting where results of required inspections, tests, or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original test was CONTRACTOR's responsibility.
   1. Cost of retesting construction revised or replaced by CONTRACTOR is CONTRACTOR's responsibility, where required tests were performed on original construction.

F. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:
   1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
   2. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
   3. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
   4. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
   5. Security and protection of samples and test equipment at the Project site.

1.03 OWNER RESPONSIBILITIES

A. Provide inspections, tests, and similar quality control services specified to be performed by independent agencies and not by CONTRACTOR, except where they are specifically indicated as CONTRACTOR's responsibility or are provided by another identified entity. Costs for these services are not included in the Contract Price.

B. Engage and pay for the services of an independent agency to perform inspections and tests specified as OWNER's responsibility.

C. OWNER will employ and pay for the services of an independent agency, testing laboratory, or other qualified firm to perform services which are OWNER's responsibility.

1.04 TESTING AGENCY RESPONSIBILITIES

A. Where OWNER has engaged a testing agency or other entity for testing and inspection of a part of the Work, and CONTRACTOR is also required to engage an entity for the same or related element, CONTRACTOR shall not employ the entity engaged by OWNER, unless otherwise agreed in writing with OWNER.

B. The independent testing agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Specification Sections shall cooperate with ENGINEER and CONTRACTOR in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.

C. The agency shall notify ENGINEER and CONTRACTOR promptly of irregularities or deficiencies observed in the Work during performance of its services.

D. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.

E. The agency shall not perform any duties of CONTRACTOR.

1.05 SUBMITTALS

A. The independent testing agency shall submit a certified written report of each inspection, test, or similar service to ENGINEER in triplicate, unless CONTRACTOR is responsible for the service. If CONTRACTOR is responsible for the service, submit a certified written report of each inspection, test, or similar service through CONTRACTOR in triplicate.

B. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

C. Written reports of each inspection, test, or similar service shall include, but not be limited to:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making the inspection or test.
   6. Designation of the Work and test method.
   7. Identification of product and Specification Section.
   8. Complete inspection or test data.
   9. Test results and an interpretation of test results.
   10. Ambient conditions at the time of sample taking and testing.
   11. Comments or professional opinion as to whether inspected or tested Work complies with Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION

A. Upon completion of inspection, testing, sample taking, and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes.

B. Protect construction exposed by or for quality control service activities and protect repaired construction.

C. Repair and protection are CONTRACTOR's responsibility regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION

SECTION 01500 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: This Section specifies procedural and administrative requirements for temporary services and facilities.

B. Temporary Utilities include, but are not limited to:
   1. Temporary electric power.
   2. Temporary lighting.

C. Temporary Construction and Support Facilities include, but are not limited to:
   1. Temporary heating facilities.
   2. CONTRACTOR's field offices and storage sheds.
   3. Sanitary facilities.
   4.

D. Construction Buildings and Facilities include, but are not limited to.
   1. Temporary enclosures.
   2. Temporary Project identification signs.
   3. Temporary Site identification signs.
   4. Temporary Project bulletin boards.
   5. Stairs.
   6. Hoists.
   7. Ongoing construction cleanup.
   8. Storage of equipment and material.

E. Security and Protection Facilities required include, but are not limited to:
   1. Temporary fire protection.
   2. Barricades, warning signs, lights.
   3. Enclosure fence for the Site.
   4. Security enclosure and lockup.
   5. Environmental protection.
   6. Control of noise.
   7. Dust control.

F. Sedimentation Control Facilities required include, but are not limited to:
   1. Soil erosion and sedimentation control.
   2. Stormwater discharge control.
   3. Slope protection.
   4. Final topography protection.

1.02 REFERENCES

A. Natural Resources and Environmental Protection Act, P.A. 451 (Act 451) of 1994.

B. Guidebook of Best Management Practices for Michigan Watersheds.

C. Local Soil Erosion Control Ordinance or requirements.

D. Michigan Manual of Uniform Traffic Control Devices (MMUTCD).

E. Codes and Standards:
   1. Comply with NFPA Code 241, "Building Construction and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library, "Temporary Electrical Facilities."
   2. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services," prepared jointly by AGC and ASC, for industry recommendations.
   3. Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).

1.03 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. CONTRACTOR shall submit the Plan of Action for Traffic Control in 6 copies within 10 days after the Notice to Proceed is issued. CONTRACTOR shall not commence Work on any State trunk line or major artery without written approval of the Plan for that portion of the Contract.
   2. Soil Erosion and Sedimentation Control Program prepared by CONTRACTOR, as specified in this Section, shall be reviewed and have received at least preliminary concurrence from the local Enforcing Agent before it will be presented and discussed at the Pre-Construction Conference, at which time final revisions may be made. Copies of the final agreed program, and Act 451 Permit, shall be delivered to ENGINEER a minimum of 2 weeks prior to beginning any Work on Site.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to:
   1. Building Code requirements.
   2. Health and Safety regulations.
   3. Utility Company regulations.
   4. Police, Fire Department, and Rescue Squad rules.
   5. Environmental Protection regulations.
   6. State and Local Soil Erosion and Sedimentation Control regulations.

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

1.05 PROJECT CONDITIONS

A. Unless otherwise provided in these Specifications, CONTRACTOR shall make CONTRACTOR's own arrangements for electricity, gas, water, and sewer services for use during the construction of the Work and shall pay for all temporary facilities, connections, extensions, and services.
   1. Cost or use charges for temporary facilities are not chargeable to OWNER or ENGINEER, and will not be accepted as a basis of claims for a Change Order.

B. Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do no overload facilities or permit them to

interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on Site.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide new materials; if acceptable to ENGINEER, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

B. Water: Provide potable water approved by local health authorities.

C. Open-Mesh Fencing: Provide 11-gauge, galvanized 2-inch, chain-link fabric fencing 6 feet high with galvanized barbed wire top strand and galvanized steel pipe posts, 1-1/2-inch inside diameter for line posts and 2-1/2-inch inside diameter for corner posts.

D. Seed: Consisting of, per acre, 10 pounds Kentucky 31 fescue, 3 pounds Birdsfoot Trefoil, and 3 pounds white clover.

E. Fertilizers: Consisting of, at least, 200 pounds per acre 12:12:12, or equivalent.

F. Mulches: Consisting of 2 tons per acre of straw or hay. Chemical mulch or other approved material may be used.

G. Traffic Control Devices:
   1. Barricades: When a road or street is closed to all through traffic, movable Type III barricades shall be erected at all points of closures, including cross streets. If barricades are to be left over night, 3 warning lights shall be provided for each Type III barricade.
   2. Barriers: Whenever the excavation on roads open to through traffic exceeds 10 feet below surface grade, portable concrete barriers shall be provided between the open trench and any traffic lanes including barriers at the ends of the trench as necessary. The maximum length of open trench shall be 50 feet.
   3. Lane Control: Provide by using drums to channel the traffic flow, supplemented by guide signs and/or flagpersons as necessary. Lighted arrow panels, Type A, shall be required for lane control on both State trunk lines and all city streets open to through traffic.
   4. Signs: Standard sign sizes and colors, as shown in "MMUTCD," shall be used to make the approach to construction areas and to direct motorists on any detour route. All signs shall be reflectorized.
   5. Temporary Pavement Marking: Complying with Section 811 of Michigan Department of Transportation’s 2003 Standard Specifications for Construction.

2.02 EQUIPMENT

A. Provide new equipment; if acceptable to ENGINEER, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.

B. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110 to 120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

C. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.

D. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.

E. Temporary Offices: Provide prefabricated or mobile units or similar on-site construction with lockable entrances, operable windows, and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.

F. Temporary Toilet Units: Provide self-contained single-occupant toilet units, properly vented and fully enclosed with a glass fiber-reinforced polyester shell or similar nonabsorbent material.

G. First Aid Supplies: Comply with governing regulations.

H. Fire Extinguishers: Provide hand-carried, portable, UL rated, Class "A" fire extinguishers for temporary offices and similar spaces.
   1. In other locations, provide hand-carried, portable, UL rated, Class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.
   2. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

I. Project Identification Signs: Provide 8-foot wide by 4-foot high Project sign as detailed, of solid cedar wood and MDO plywood, painted, with exhibit lettering by a professional sign painter, with final graphics as approved by ENGINEER.

J. Bulletin Board: Provide a weather-protected enclosed bulletin board at Site. The bulletin board shall be mounted in a conspicuous and public outside location.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they shall serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

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

3.02 TEMPORARY UTILITY INSTALLATION

A. Engage the appropriate local utility company to install temporary service or to connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.
   1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.

B. Water Service and Distribution: CONTRACTOR shall at all times provide for CONTRACTOR's employees an abundant and convenient supply of cool drinking water taken from a potable source.

C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground fault interrupters, and main distribution switchgear.
   1. Except where overhead service must be used, install electric power service underground.
   2. Install wiring overhead, and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 volts, AC 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

D. Temporary Lighting: Wherever overhead floor or roof deck has been installed, provide temporary lighting with local switching.
   1. Install and operate temporary lighting that shall fulfill security and protection requirements, without operating the entire system, and shall provide adequate illumination for construction operations and traffic conditions.

E. Public and Private Utilities: Where any utilities, water, sewer, gas, telephone, or any other either public or private, are encountered, CONTRACTOR must provide adequate protection for them, and CONTRACTOR shall be held responsible for any damages to such utilities arising from CONTRACTOR's operations.
   1. When it is apparent that construction operations may endanger the foundation of any utility conduit or the support of any structure, CONTRACTOR shall notify the utility Owner of this possibility and CONTRACTOR shall take such steps as may be required to provide temporary bracing or support of conduits or structures.
   2. Where it is the policy of utility Owners to make repairs to damaged conduit or other structures, CONTRACTOR shall cooperate to the fullest extent with the utility, and CONTRACTOR shall see that CONTRACTOR's operations interfere as little as possible with those operations.
   3. When it is necessary to carry out the Work, that an electric, telephone, or light pole be moved to a new location, or moved and replaced after construction, CONTRACTOR shall arrange for the moving of such poles and the lines thereof, and shall pay any charges therefor.
   4. Where existing utilities are encountered along the line of Work, CONTRACTOR shall perform CONTRACTOR's operations in such a manner that service will not be interrupted, and shall, at CONTRACTOR's own expense, make all temporary provisions to maintain service.
   5. Unless otherwise indicated on Drawings, CONTRACTOR shall replace any disturbed sewer or drain, or relay same at a new grade to be established by ENGINEER, such that sufficient clearance for the sewer will be provided.
   6. CONTRACTOR will receive no extra compensation for replacement of sewers or drains encountered, or for relaying at a new grade and/or line where necessary, except where specifically noted otherwise on Drawings or Specifications.
   7. Where existing gas mains and services are encountered, CONTRACTOR shall arrange with the gas company for any necessary relaying, and shall pay for the cost of such work.
   8. Materials used in repairing or relaying utilities shall be the same type and strength as the existing Work.

F. Storm and Sanitary Sewers: If sewers are available, CONTRACTOR may provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide portable units.

1. If gas is present in existing sewers or tanks where CONTRACTOR must work, they shall be cleared of gas before entering. If the gas cannot be removed by natural ventilation by the removal of covers, CONTRACTOR shall maintain forced draft to render the area safe as determined by gas detection equipment.
2. Filter out excessive amounts of soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
3. Connect temporary sewers to the municipal system as directed by the sewer department officials.
4. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.
5. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.

3.03 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
   1. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to OWNER.
   2. Provide incombustible construction for offices, shops, and sheds located within the construction area, or within 30 feet of building lines. Comply with requirements of NFPA 241.

B. Temporary Heating Facilities: Provide temporary heat required by construction activities for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
   1. Except where use of the permanent system is authorized, provide vented self-contained LP gas or fuel oil heaters with individual space thermostatic control.
   2. Use of gasoline-burning space heaters, open flame, or salamander-type heating units is prohibited.

C. CONTRACTOR's Field Offices: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at Site. Keep the office clean and orderly for use for small progress meetings.

D. Sanitary Facilities: Sanitary facilities include temporary toilets, wash facilities, and drinking water fixtures. Comply with regulations and health Codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best service the Project's needs.
   1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material.
   2. Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.
   3. Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.
   4. Provide safety showers, eyewash fountains and similar facilities where needed for safety and sanitation of personnel.

E. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 2 Sections. Where feasible, utilize the same facilities. Maintain the Site, excavations, and construction free of water.

3.04 CONSTRUCTION BUILDINGS AND FACILITIES INSTALLATION

A. Storage platforms, sheds, temporary closures for doors, windows and other openings of buildings, temporary sidewalks, runways, and ladders shall be provided.
   1. Hazardous areas shall be protected by guardrails and fences. Storage platforms and sheds shall be provided for materials which require protection from the weather.
   2. Sheds shall be substantially constructed and covered with "ready roofing." Doors, windows, and other openings in the permanent work shall be closed as soon as necessary to safeguard the construction and materials from tampering or damage.
   3. Enclosures for openings easily accessible from the exterior shall be of solid wood or sash, provided with necessary hardware and padlocks. Other openings shall be enclosed by old sash or canvas on wooden frames for the protection of the building against damage by weather.
   4. Enclosures shall be weathertight and secured in such manner as not to damage the finish of the building.

B. Temporary Enclosures: Provide temporary enclosure for protection of construction in progress and completed, from exposure, foul weather, other construction operations and similar activities.
   1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
   2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 square feet or less with plywood or similar materials.
   3. Close openings through floor or roof decks and horizontal surfaces with load-bearing wood-framed construction.

C. Temporary Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated. Verify with ENGINEER final wording of graphics to be placed on sign and final location of sign. Obtain sign permit from local authority.

D. Temporary Site Identification and Signs: Prepare Site identification and other signs of the size indicated; install signs where indicated or as directed by ENGINEER to inform construction personnel, public and visitors seeking entrance to Site. Do not permit installation of unauthorized signs.

E. Temporary Project Bulletin Board: As a minimum, the following items must be posted:
   1. Wage Rates (when applicable).
   2. Safety Poster (OSHA or State OSHA).
   3. Nondiscrimination Poster.
   4. Equal Employment Opportunity Statement signed by a Company official.
   5. Grading Permit (Soil Erosion and Sedimentation Control Act 451).

F. Hoists: CONTRACTOR shall provide temporary hoists to lift building materials and equipment to the intended areas. Hoists shall be capable of carrying the intended load without exceeding the load limitation of the hoisting device.

G. Ongoing Construction Cleanup: Project cleanup shall be an ongoing operation. CONTRACTOR shall maintain an order of neatness and good housekeeping comparable to that maintained by OWNER. Project cleanup applies to the Site and all areas affected by construction operations. CONTRACTOR shall:
   1. Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 degrees F (27 degrees C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.
   2. Maintain dirt and debris resulting from CONTRACTOR's operations in designated spoil piles as approved by ENGINEER or remove from the Site daily. Dirt and debris shall not collect or interfere with OWNER's facility operations. Excess dirt and debris shall be removed from the Site as needed to confine spoil piles in designated areas.
   3. Keep tools, equipment, and materials in a neat and orderly arrangement.
   4. Maintain culverts, sewers, and drainage structures by removing sediment and debris from construction operations.
   5. Repair all holes and ruts resulting from construction operations that affect OWNER's use of property with approved material; compact, level, and restore.

H. Storage of Equipment and Material: Pumps and other machinery units shall be stored in weathertight structures provided by CONTRACTOR.
   1. Motors, electrical switchgear, gauges, and other equipment of a delicate nature, as determined by ENGINEER, shall be stored in weathertight warehouses which are maintained at a temperature of at least 60 degrees F.
   2. Structural steel, miscellaneous and cast iron items may be placed in open yard storage, but any such items having attached motors or other machinery units shall have such units well wrapped with waterproof paper or cloth for protection from the weather.
   3. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of ENGINEER.
   4. Materials and equipment distributed, stored, and placed upon or near the Site of the Work shall at all times be so disposed as not to interfere with work prosecuted by OWNER or other Contractors in the employment of OWNER or with drainage. Materials and equipment shall not be stored on public streets.

3.05 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer as requested by ENGINEER.

B. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10, "Standard for Portable Fire

Extinguishers," and NFPA 241, "Standard for Safeguarding Construction, Alterations and Demolition Operations."

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than 1 extinguisher on each floor at or near each usable stairwell.
2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

C. Barricades, Warning Signs, and Lights: Comply with Standards and Code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.

D. Enclosure Fence for the Site: When excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire Site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the Site, except by the entrance gates.

1. Provide open-mesh, chain-link fencing with posts set in a compacted mixture of gravel and earth.

E. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

1. Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

F. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise-making tools and equipment to hours that will minimize complaints from persons or firms near the Site.

G. Control of Noise: CONTRACTOR shall eliminate noise to as great an extent as possible at all times. Air compressors shall be equipped with silencers, and the exhaust of all gasoline motors and other power equipment shall be provided with mufflers.

H. On-Site Burning: Burning of waste materials resulting from the Work under this Contract will not be allowed unless authorized in writing by OWNER. Where burning is not allowed, CONTRACTOR shall haul all waste materials from Site and dispose of same in a manner acceptable to ENGINEER.

1. The costs of hauling and disposal of waste materials shall be included in other items of the Work under this Contract.

I. Dust Control: CONTRACTOR shall take all steps necessary for the alleviation or prevention of dust nuisance caused by or resulting from CONTRACTOR's operations and shall apply water or dust palliative, or both, as required. No direct payment will be made for any such Work performed or materials used to control dust from this Contract.

3.06 TRAFFIC CONTROL FACILITIES INSTALLATION

A. Traffic Control Plan of Action: CONTRACTOR's Plan of Action shall be based upon OWNER's requirements for Traffic Control and shall detail specific detour routes including individual sign markings and locations. CONTRACTOR shall also propose CONTRACTOR's intended method for lane control within the construction Work areas. The Plan of Action shall include long-term maintenance of traffic control devices for Work that is not completed during a construction season or for extended periods when Work is not performed.
   1. OWNER and/or MDOT shall approve the proposed Plan of Action. Modifications to the proposed Plan of Action resulting in changes to the Bid quantities shall be adjusted as required during CONTRACTOR's submittal of monthly payment estimates.
   2. In addition to the Plan of Action, this Work shall consist of the furnishing, installation, operation, maintenance, and removal of the traffic control devices described in this Section.
   3. The location, type, and wording of warning and guide signs shall be proposed by CONTRACTOR as part of CONTRACTOR's required Plan of Action for Traffic Control.

B. Maintenance of Traffic: During the progress of Work, CONTRACTOR shall accommodate both vehicular and pedestrian traffic as provided in these Specifications and as indicated on Drawings.
   1. In the absence of specific requirements, CONTRACTOR shall maintain such traffic. Access to fire hydrants, water, and gas valves shall always be maintained.
   2. CONTRACTOR's truck and equipment operations on public streets shall be governed by all local traffic ordinances and regulations of the Fire and Police Departments and the Department of Public Works. Work within State highway rights-of-way shall be under the jurisdiction of the Michigan Department of Transportation.
   3. Small street openings necessary for manholes, alignment holes, pipe connections, etc., will be permitted. Such holes shall not be open longer than necessary and shall be protected in accordance with the requirements of the local agency having jurisdiction, and any traffic detouring necessary shall be done to the satisfaction of the Agency. Whenever possible, small openings shall be covered with steel plates at pavement level and secured in place at the time that Work is being performed.
   4. Where streets are partially obstructed, CONTRACTOR shall place and maintain temporary driveways, ramps, bridges and crossings which, in the opinion of ENGINEER, are necessary to accommodate the public. As part of the Work under this Contract, CONTRACTOR shall be responsible for providing and maintaining flagpersons, warning lights, signs, and/or barricades, including necessary detour signs outside the Project limits as required to direct and protect vehicular and pedestrian traffic. In the event of CONTRACTOR's failure to comply with the foregoing provisions, OWNER may, with or without notice, cause the same to be done and deduct the cost of such Work from any monies due or to become due CONTRACTOR under this Contract; but the performance of such Work by OWNER, or at OWNER's insistence, shall serve in no way to release CONTRACTOR from CONTRACTOR's liability for the safety of the traveling public.
   5. CONTRACTOR shall inform the local Fire Department in advance of CONTRACTOR's program of street obstruction and detours, so that the Fire Department can set up plans for servicing the area in case of an emergency. CONTRACTOR shall also notify the public agency having jurisdiction over the roads at least 1 week prior to obstructing a road.

3.07 SEDIMENTATION CONTROL FACILITIES INSTALLATION

A. Soil Erosion and Sedimentation Control: CONTRACTOR shall take all precautions necessary to prevent soil erosion of areas disturbed by the construction and shall ensure that all soil erosion be contained within the construction Site. CONTRACTOR shall provide temporary slope protection, temporary dikes, etc., as required to prevent eroded materials from entering any sewers or natural watercourses.

1. CONTRACTOR shall comply with Natural Resources and Environmental Protection Act, P.A. 451 (Act 451) of 1994, Part 91 of the Michigan Complied Laws and local city or county soil erosion control programs.
2. CONTRACTOR shall prepare a Soil Erosion and Sedimentation Control Program for submittal to and approval by Local Soil Erosion and Sedimentation Control Agent prior to start of construction, as required in the following paragraphs. Copies of State guidelines "Better Environment through Soil Erosion and Sedimentation Control" and "Protection of Natural Resources" DEQ Handbook of Specifications may be obtained at no charge from the Michigan Department of Environmental Quality (MDEQ). The "Michigan Soil Erosion and Sedimentation Control Guidebook" and the "Guidebook of Best Management Practices for Michigan Watersheds" may also be obtained from MDEQ.
3. Since it is impractical to identify specific potential soil erosion problems along a water main route, CONTRACTOR, after award but prior to the Pre-Construction Conference, together with the local soil erosion Enforcing Agent, shall identify all potential soil erosion problem areas and prepare a detailed Soil Erosion and Sedimentation Control Program satisfying CONTRACTOR's specific method of operation. This program shall include as a minimum, but not necessarily be limited to, the following:
    a. Identify on a separate set of Drawings all soil erosion problem areas.
    b. Identify specific control structure using DEQ United Keying System from the "Michigan Soil Erosion and Sedimentation Control Guidebook" to be placed to control erosion and to prevent soil from entering storm sewers and streams.
    c. Indicate timing of placement and removal of structures both in relationship to time of year and to sequence of construction.
    d. Indicate timing of completion of cleanup and surface restoration after control structures are removed.
4. The Soil Erosion and Sedimentation Control Program, prepared by CONTRACTOR, shall be reviewed and have received at least preliminary concurrence from the local Enforcing Agent before it will be presented and discussed at the Pre-Construction Conference, at which time final revisions may be made. Copies of the final agreed program shall be made available for ENGINEER and the local Enforcing Agent. Should the local regulatory agency determine at any time during construction that the construction operation is in violation of the Act and cite OWNER, CONTRACTOR or subcontractor shall take immediate action, as directed by OWNER, to ensure compliance with the Act.

B. Slope Protection: On slopes greater than 20 percent, but not immediately adjacent to stream crossing, mulch shall be anchored with a spray of asphalt, Type SS-1S emulsion mixed with an equal amount of water at a rate of 200 gallons per acre. Chemical self-adhering mulch may be used. Mulch shall be anchored on slopes greater than 10 percent if immediately adjacent to stream crossings. Mulch may also be held in place by discing with a farm disc. If mulch materials such as netting or excelsior blankets are used, they may have to be pegged.

C. Final Topography Protection: When final topography has been established, all bared soil shall be seeded, fertilized, and mulched in an effort to restore to a protected condition, except in flat, active farm fields.

1. The permanent protection measures shall be in effect not more than 30 days after the earth change is completed, except at tie-in areas at both sides of the stream where temporary

measures will be installed within 3 days following a pipeline crossing. Temporary measures may include a row of sandbags at the top of the bank, a row of pegged bales of straw, or an earth berm or diversion ditch. These temporary measures shall be maintained until permanent measures are installed.

2. Where construction involves placing pipes in roadways or under other impervious materials, special care shall be provided by CONTRACTOR.
3. Provide control measures at all storm sewer catch basins by providing straw or other types of filters or construct sediment traps adjacent to inlets.
4. If a roadway has a grass ditch area, minimize disturbance and provide filter berms (straw or gravel) or sediment traps as appropriate.
5. Provide proper downdrain structures to control increased runoff to streams and drains.
6. Stabilize the roadway as soon as possible after placement of the utility. Temporary erosion control measures shall be instituted until final paving is complete. Such measures may include a subbase surfacing application or gravel surfacing. Compaction of soil may suffice if other control measures are effected.

3.08 FIELD QUALITY CONTROL

A. Any unforeseen situations that may be encountered during the course of construction that may cause accelerated erosion and deposition of sediment into waterways and/or lakes shall be controlled by methods that may include sediment traps, sediment basins, or holding ponds. Any slope failures or development of gullies after construction has been completed shall be corrected immediately.

B. Should the local Regulatory Agency determine at any time during construction that the construction operation is in violation of the Natural Resources and Environmental Protection Act, P.A. 451 (Act 451) of 1994 and cite OWNER, CONTRACTOR or Subcontractor shall take immediate action, as directed by OWNER, to ensure compliance with the Act.

3.09 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour-day basis where required to achieve indicated results and to avoid possibility of damage.

C. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

D. Termination and Removal: Unless ENGINEER requires that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of CONTRACTOR. OWNER reserves the right to take possession of Project identification signs.

2. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period including, but not limited to:
   a. Replace air filters and clean inside of ductwork and housings.
   b. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
   c. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION

SECTION 01730 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Related Sections:
   1. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 15 and Division 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.
   2. Demolition of selected portions of the building for alterations is included in Section 02225.

1.02 SUBMITTALS

A. Cutting and Patching Proposed Method: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval from ENGINEER to proceed.

1.03 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in ENGINEER's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance shall equal or surpass that of existing materials.

PART 3 - EXECUTION

3.01 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

3.02 PREPARATION

A. Prior to any cutting, coordinate with OWNER and ENGINEER to verify that all lines are drained and isolated and all conduits have been deenergized.

B. Provide temporary support of Work to be cut.

C. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

D. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

E. Take all precautions necessary to avoid cutting existing pipe, conduit, or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

A. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

B. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

C. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.
   1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
   3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.

D. Comply with requirements of applicable Sections of Division 2 where cutting and patching requires excavating and backfilling.

E. Cap, valve or plug, and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after bypassing and cutting.

F. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
   1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
   2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   3. Patch, repair or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.04 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty, and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION

SECTION 01770 - CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements for Contract closeout including, but not limited to:
   1. Warranties and Bonds.
   2. Requirements for Substantial Completion.
   3. Project record document submittal.
   4. Equipment acceptance.
   5. Operating and maintenance manual submittal.
   6. Final cleaning.

B. Refer to the General Conditions for terms of CONTRACTOR's special warranty of workmanship and materials.

C. Specific requirements for warranties for the Work and products and installation that are specified to be warranted, are included in the individual Sections of Divisions 2 through 16.

D. Certifications and other commitments and agreements for continuing services to OWNER are specified elsewhere in the Contract Documents.

1.02 WARRANTY REQUIREMENTS

A. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve CONTRACTOR of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with CONTRACTOR.

B. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

C. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

D. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. CONTRACTOR is responsible for the cost of replacing or rebuilding defective Work regardless of whether OWNER has benefited from use of the Work through a portion of its anticipated useful service life.

E. OWNER's Recourse: Written warranties made to OWNER are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which OWNER can enforce such other duties, obligations, rights, or remedies.

F. Rejection of Warranties: OWNER reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

G. OWNER reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.03 SUBSTANTIAL COMPLETION

A. Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
   1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documents for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Price.
   2. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
   3. Advise OWNER of pending insurance changeover requirements.
   4. Submit specific warranties, workmanship bonds, maintenance agreements, record drawings, maintenance and operation manuals, final certifications, and similar documents.
   5. Obtain and submit releases enabling OWNER unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates, and similar releases.
   6. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.
   7. Instruction of OWNER's operation and maintenance personnel.

B. Inspection Procedures: On receipt of a request for inspection, ENGINEER will either proceed with inspection or advise CONTRACTOR of unfilled requirements.
   1. Equipment shall meet all performance requirements in corresponding specification sections and have had approved Operation and Maintenance Manuals and training provided to the OWNER's personnel.
   2. ENGINEER will prepare the Certificate of Substantial Completion following inspection, or advise CONTRACTOR of construction that must be completed or corrected before the certificate will be issued.
   3. ENGINEER will repeat inspection when requested and assured that the Work has been substantially completed.
   4. Results of the completed inspection will form the basis of requirements for final acceptance.

C. The warranty period for specific portions of the Work will begin on the date established on Component Acceptance Form or at such other date as agreed by OWNER, ENGINEER, and CONTRACTOR.

1.04 FINAL ACCEPTANCE

A. Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
   1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
   2. Submit an updated final statement, accounting for final additional changes to the Contract Price.

3. Submit a copy of ENGINEER's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by ENGINEER.
4. Submit to OWNER furnished consent of surety to final payment.
5. Submit a final liquidated damages settlement statement.
6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
7. Submit record drawings, maintenance manuals, final Project photographs, damage or settlement survey, property survey, and similar final record information.
8. Deliver tools, spare parts, extra stock, and similar items.
9. Make final changeover of permanent locks and transmit keys to OWNER. Advise OWNER's personnel of changeover in security provisions.
10. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

B. Reinspection Procedure: ENGINEER will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to ENGINEER.
1. Upon completion of reinspection, ENGINEER will prepare a certificate of final acceptance, or advise CONTRACTOR of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, reinspection will be repeated.

1.05 SUBMITTALS

A. Submit written warranties to ENGINEER prior to the date certified for Substantial Completion. If ENGINEER's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of ENGINEER.

B. When a designated portion of the Work is completed and occupied or used by OWNER, by separate agreement with CONTRACTOR during the construction period, submit properly executed warranties to ENGINEER within 15 days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by CONTRACTOR, or CONTRACTOR and a subcontractor, supplier, or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to OWNER through ENGINEER for approval prior to final execution.

D. Refer to individual Sections of Divisions 2 through 16 for specific content requirements, and particular requirements for submittal of special warranties.

1.06 RECORD DOCUMENT SUBMITTALS

A. Record Drawings:
1. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown.
2. Mark whichever Drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on Contract

Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

3. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
4. Mark new information that is important to OWNER, but was not shown on Contract Drawings or Shop Drawings.
5. Note related Change Order numbers where applicable.
6. Organize Record Drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates, and other identification on the cover of each set.

B. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work.
   1. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to ENGINEER for OWNER's records.

C. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01600, operation and maintenance manuals for items included under this Section.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 COMPONENT ACCEPTANCE

A. Component Acceptance Certificate: For each item of equipment incorporated into the Project, ENGINEER will issue a Component Acceptance Certificate as shown in Section 00625.

B. The certificate will certify that the equipment installation is complete, that manufacturer-provided inspection and start-up services and training have taken place, and that OWNER has beneficial use of the equipment.

C. The data on the Component Acceptance Certificate may be used to establish the time of beginning for the warranty period for that piece of equipment, if OWNER begins to use it at that time.

3.02 FINAL CLEANING

A. General cleaning during construction is required by the General Conditions and included in Section 01500.

B. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

C. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
   1. Remove labels that are not permanent labels.

2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
5. Clean Site, including landscape development areas, of rubbish, litter, and foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth even-textured surface.

D. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

E. Comply with regulations of authorities having jurisdiction and safety standards for cleaning.
1. Do not burn waste materials. Do not bury debris or excess materials on OWNER's property.
2. Do not discharge volatile, harmful, or dangerous materials into drainage systems.
3. Remove waste materials from Site and dispose of in a lawful manner.

F. Where extra materials of value remaining after completion of associated Work have become OWNER's property, arrange for disposition of these materials as directed.

END OF SECTION

SECTION 02411
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.
2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 017300 "Execution" for cutting and patching procedures.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Engineering Survey: Submit engineering survey of condition of building.

B. Survey of Existing Conditions: Submit survey.

C. Schedule of selective demolition activities with starting and ending dates for each activity.

D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Universal certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

A. Owner will not occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner may remove equipment.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials:

1. It is not expected that hazardous materials will be encountered in the Work.
   a. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. On-site sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video. Comply with Section 013233 "Photographic Documentation."

1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

A. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location and reinstalled in their original locations after selective demolition operations are complete.

B. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

A. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
1. Arrange to shut off utilities with utility companies.
2. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
3. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.

4. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:

a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.

3.4 SALVAGE/REINSTALL

A. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least 4 hours after flame-cutting operations.

5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 031000
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.

B. Openings for other work.

C. Form accessories.

D. Form stripping.

1.02 RELATED REQUIREMENTS

A. Section 032000 - Concrete Reinforcing.

B. Section 033000 - Cast-in-Place Concrete.

C. Section 042000 - Unit Masonry: Reinforcement for masonry.

D. Section 051200 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

C. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

D. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

G. PS 1 - Structural Plywood; 2023.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.

C. Chamfer outside corners of beams, joists, columns, and walls.

D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

E. Comply with relevant portions of ACI CODE-318, ACI PRC-347, and ACI SPEC-301.

F. Use the following form types:

1. Basement Walls Not Exposed To View: Site fabricated plywood.

2. Basement Walls Exposed To View: Site fabricated rough sawn lumber.

3. Elevated Floor Slabs: Prefabricated glass fiber pan forms, treated for exposed to view finish.

4. Elevated Floor/Roof Slabs: Permanent prefabricated foam panel formwork; formwork to remain.

2.02 WOOD FORM MATERIALS

A. Form Materials: At the discretion of the Contractor.

2.03 REMOVABLE PREFABRICATED FORMS

A. Manufacturers:

1. Molded Fiber Glass Construction Products Co; _____: www.mfgcp.com/#sle.

2. S-Form; Aluminum Formwork Systems: www.s-form.us/#sle.

B. Preformed Steel Forms: Minimum 16 gauge, 0.0598 inch thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Preformed Aluminum Forms: ASTM B221 (ASTM B221M), 6061-T6 alloy, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

D. Pan Type: Glass fiber, of size and profile indicated.

2.04 PERMANENT SITE-FABRICATED STEEL MESH FORMING SYSTEM

A. Manufacturers:

1. Alabama Metal Industries Corporation; Stay-Form: www.amicoglobal.com/#sle.

2.05 PERMANENT PREFABRICATED FOAM PANEL FORMWORK

A. Floor/Roof Deck Forms: Pre-engineered expanded polystyrene foam plastic deck and beam/joist forms with factory installed metal channel furring strips flush with face of panel and field installed form stiffener slots.

1. Structural Performance: In accordance with applicable code.

2. Form Cross Section: As indicated on drawings; flat-bottomed solid foam blocks with voids only for stiffeners and beam/joist cross-section; interlocking long edges.

2.06 FORMWORK ACCESSORIES

A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.

1. Do not use materials containing diesel oil or petroleum-based compounds.

2. Composition: Vegetable oil and mineral oil blend.

a. VOC Content: In compliance with applicable local, State, and federal regulations.

3. Composition: Vegetable-derived oil blend.

a. VOC Content: In compliance with applicable local, State, and federal regulations.

C. Dowel Sleeves: Plastic sleeve and nailable plastic base for smooth, round, steel load-transfer dowels.

D. Filler Strips for Chamfered Corners: Wood strip type; 1 inch size; maximum possible lengths.

E. Dovetail Anchor Slot: Galvanized steel, at least 22 gauge, 0.0299 inch thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork. Provide _____ manufactured by _____ .

F. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 051200.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.03 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI SPEC-301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Install stay in place mesh steel formwork in accordance with manufacturer's recommendations.

D. Install permanent insulated foam panel formwork per manufacturer's recommendations.

3.04 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals specified in Section 042613.

E. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean and protect permanent insulated concrete foam panel formwork per manufacturer's recommendations.

C. Clean formed cavities of debris prior to placing concrete.

1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.07 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

C. Do not reuse wood formwork more than 4 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.08 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION 031000

SECTION 032000
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.

B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 042000 - Unit Masonry: Reinforcement for masonry.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI MNL-66 - ACI Detailing Manual; 2020.

C. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

D. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2024.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

F. CRSI (DA4) - Manual of Standard Practice; 2024.

G. CRSI (P1) - Placing Reinforcing Bars, 10th Edition; 2019.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Comply with requirements of ACI MNL-66 Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301.

1. Maintain one copy of each document on project site.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).

1. Plain billet-steel bars.

B. Reinforcement Accessories:

1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.

2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.02 RE-BAR SPLICING:

A. Coupler Systems: Mechanical devices for splicing reinforcing bars.

1. Comply with ACI CODE-318 steel reinforcing design strength requirements for splices in tension and compression.

B. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for splicing reinforcing bars.

1. Comply with ACI CODE-318 steel reinforcing design strength requirements for splices in tension and compression.

2.03 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Welding of reinforcement is not permitted.

C. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION

3.01 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Accommodate placement of formed openings.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 014000 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

END OF SECTION 032000

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete foundation walls.

B. Miscellaneous concrete elements, including equipment pads

C. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 031000 - Concrete Forming and Accessories: Forms and accessories for formwork.

B. Section 032000 - Concrete Reinforcing.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

C. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

D. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.

E. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.

F. ACI PRC-308 - Guide to External Curing of Concrete; 2016.

G. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

H. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

I. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

J. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

K. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

L. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

M. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2024.

N. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

O. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

P. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

Q. ASTM C157/C157M - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete; 2017.

R. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.

S. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2024a.

T. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.

U. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.

V. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

W. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements; 2021.

X. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2025a.

Y. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2024.

Z. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2025.

AA. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

BB. ASTM C1202 - Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration; 2019.

CC. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2020.

DD. ASTM C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method); 2021.

EE. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2019.

FF. ASTM C1582/C1582M - Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete; 2024.

GG. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.

HH. ASTM D8139 - Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction; 2023.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.

2. For membrane-forming, moisture emission-reducing, curing and sealing compound, provide manufacturer's installation instructions,.

C. Mix Design: Submit proposed concrete mix design.

1. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.

2. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.

3. Indicate proposed mix design complies with admixture manufacturer's written recommendations.

D. Test Reports: Submit report for each test or series of tests specified.

E. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

F. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.

1. Maintain one copy of each document on site.

B. Follow recommendations of ACI PRC-305 when concreting during hot weather.

C. Follow recommendations of ACI PRC-306 when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 031000.

2.02 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 032000.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.

1. Acquire cement for entire project from same source.

B. Blended Hydraulic Cement: ASTM C595/C595M, Type IS(20), Type IP(15), and Type IL(10).

C. Fine and Coarse Aggregates: ASTM C33/C33M.

1. Acquire aggregates for entire project from same source.

D. Fly Ash: ASTM C618, Class F.

E. Ground Granulated Blast Furnace Slag: ASTM C989/C989M.

F. Silica Fume: ASTM C1240, proportioned in accordance with ACI PRC-211.1.

G. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Chemical Admixture:

B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

C. Air Entrainment Admixture: ASTM C260/C260M.

D. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

E. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

F. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.

G. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

H. Accelerating Admixture: ASTM C494/C494M Type C.

I. Retarding Admixture: ASTM C494/C494M Type B.

J. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

A. Non-Shrink Cementitious Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents.

1. Grout: Comply with ASTM C1107/C1107M.

2.06 CURING MATERIALS

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.

1. Product dissipates within 4 to 6 weeks.

2. Provide product containing fugitive red dye.

C. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.

1. Comply with ASTM C309 standards for water retention.

2. Compressive Strength of Treated Concrete: Equal to or greater than strength after 14-day water cure when tested in accordance with ASTM C39/C39M.

3. VOC Content: Zero.

2.07 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.

1. For trial mixtures method, employ independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete:

1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4500 pounds per square inch.

2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.

3. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.

4. Water-Cement Ratio: Maximum 40 percent by weight.

5. Total Air Content: 6 percent, determined in accordance with ASTM C173/C173M.

6. Maximum Aggregate Size: 5/8 inch.

2.08 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

B. Transit Mixers: Comply with ASTM C94/C94M.

C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PLACING CONCRETE

A. Place concrete in accordance with ACI PRC-304.

B. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

C. Ensure reinforcement will not be disturbed during concrete placement.

D. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

3.03 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:

1. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.

3.04 CURING AND PROTECTION

A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

1. Normal concrete: Not less than seven days.

2. High early strength concrete: Not less than four days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

3.05 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.06 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Engineer and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

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

3.07 SCHEDULE - CONCRETE TYPES AND FINISHES

A. Foundation Walls: 3,000 pounds per square inch 28 day concrete, form finish with honeycomb filled surface.

END OF SECTION 033000

SECTION 034113
PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast roof planks.

B. Connection plates with brackets and hangers.

C. Grouting plank joint keys.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

E. ASTM A416/A416M - Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete; 2024.

F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

G. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products; 2021.

H. PCI MNL-120 - PCI Design Handbook; 2017, with Errata (2021).

I. PCI MNL-123 - Connections Manual: Design and Typical Details of Connections for Precast and Prestressed Concrete; 1988.

J. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete; 2011.

K. PCI MNL-126 - PCI Manual for the Design of Hollow Core Slabs and Walls; 2015.

L. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; 2000.

M. PCI (CERT) - PCI Plant Certification; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate location of hanger tabs and devices for mechanical and electrical work and cutting of field openings.

B. Preinstallation Meeting: Convene one week before starting work of this section.

1. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate standard component configuration, design loads, deflections, and cambers.

C. Shop Drawings: Indicate plank locations, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design precast concrete hollow core planks under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

B. Mark each member with date of production and final position in structure.

PART 2 PRODUCTS

2.01 PRECAST UNITS

A. Precast Hollow Core Planks: Comply with PCI MNL-120, PCI MNL-126, PCI MNL-124 ACI CODE-318, and ACI SPEC-301.

1. Design components to withstand dead loads and design loads in the configuration indicated on drawings.

2. Design connections in accordance with PCI MNL-123.

3. Design components to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.

2.02 MATERIALS

A. Concrete Materials: ACI SPEC-301.

B. Tensioning Steel Tendons: ASTM A416/A416M, Grade 250 - 250K psi; seven-wire stranded steel cable; low-relaxation type; full length without splices; weldless; uncoated.

C. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) deformed steel bars.

D. Non-Shrink Grout: Non-metallic, minimum compressive strength of 10,000 psi at 28 days.

2.03 ACCESSORIES

A. Connecting and Supporting Devices: Plates, angles, items cast into concrete, items connected to steel framing members, and inserts: ASTM A36/A36M carbon steel; hot-dip galvanized in accordance with ASTM A153/A153M.

B. Core Hole End Plugs: Cardboard insert with stiff concrete fill.

C. Hanger Tabs: Galvanized steel, designed to fit into grouted key joints, capable of supporting 500 lbs dead load, predrilled to receive hanger.

D. Bearing Pads: High density plastic, 1/8 inch thick, smooth on one side. Neoprene (Chloroprene).

E. Sill Seal: Compressible glass fiber strips.

2.04 FABRICATION

A. Embed anchors, inserts, plates, angles, and other items at locations indicated.

B. Provide openings required by other sections, at locations indicated.

C. Cut exposed ends flush.

2.05 FABRICATION TOLERANCES

A. Comply with PCI MNL-116 and PCI MNL-135.

2.06 SOURCE QUALITY CONTROL

A. Produce planks in accordance with requirements of PCI MNL-116. Maintain plant records and quality control program during production of precast planks. Make records available upon request.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and field measurements are as indicated on shop drawings.

3.02 PREPARATION

A. Prepare support devices for the erection procedure and temporary bracing.

3.03 ERECTION

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Install bearing pads and sill seal at bearing ends of planks as indicated.

C. Align and maintain uniform horizontal and end joints, as erection progresses.

D. Maintain temporary bracing in place until final connection is made. Protect members from staining.

E. Adjust differential camber between precast members to tolerance before final attachment and grouting.

F. Grout longitudinal keys as indicated.

G. Tape seal underside of plank joints to prevent grout leakage.

3.04 TOLERANCES

A. Erect members level and plumb within allowable tolerances. Comply with PCI MNL-135.

3.05 PROTECTION

A. Protect members from damage caused by field welding or erection operations.

3.06 CLEANING

A. Clean weld marks, dirt, and blemishes from surface of exposed members.

END OF SECTION 034113

SECTION 04200
UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Lintels.
3. Brick.
4. Mortar and grout materials.
5. Reinforcement.
6. Embedded flashing.
7. Accessories.
8. Mortar and grout mixes.

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For reinforcing steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R.

C. Samples: For each type and color of exposed masonry unit and colored mortar.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product and for masonry units, include material test reports substantiating compliance with requirements.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

1.6 FIELD CONDITIONS

A. 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.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, use the equivalent thickness method for masonry units in accordance with ACI 216.1.

2.2 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.

B. CMUs: ASTM C90, normal weight.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.

2.3 LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

B. Offset Angle Supports: Steel plate brackets anchored to structure, allowing continuous insulation behind shelf angle supporting veneer.
   1. Carbon Steel, Galvanized after Fabrication: ASTM A1008/A1008M.

2.4 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

   1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW, Type FBX.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 6000 psi.
   2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
   3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
   4. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, 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 will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

E. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime, sand, and admixtures and complying with ASTM C1714/C1714M.

F. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. White-Mortar Aggregates: Natural white sand or crushed white stone.

G. Aggregate for Grout: ASTM C404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C1384, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

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 ft. , with prefabricated corner and tee units.

C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

D. Masonry-Joint Reinforcement for Multiwythe Masonry:
1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.7 EMBEDDED FLASHING

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.

2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft.. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

2.8 ACCESSORIES

A. Weep/Cavity Vents: Use the following unless otherwise indicated:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a.

B. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Mortar Deflector: Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches that prevent clogging with mortar droppings.

a.

C. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. 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. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.

2. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type S.

D. Pigmented Mortar: Use colored cement product.
1. Mix to match Architect's sample.
2. Application: Use pigmented mortar for exposed mortar joints with the following units: Brick.

E. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, paragraph 4.2.1.2 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 in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. 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.

B. 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.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 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 ft., 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., 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 ft., or 1/2-inch maximum.

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 head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 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 bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 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. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
1. hollow masonry units, embed ends in mortar-filled cores.

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together as follows:
1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement to allow for differential movement regardless of whether bed joints align.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.

D. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry.
3. At lintels and shelf angles, extend flashing 6 inches minimum, to edge of next full unit at each end. At heads and sills, extend flashing 6 inches minimum, to edge of next full unit and turn ends up not less than 2 inches to form end dams.

C. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Space weep holes 24 inches o.c. unless otherwise indicated.
3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Accessories" Article.

E. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.8 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace,

tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Testing Prior to Construction: One set of tests.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.

E. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

3.10 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.11 MASONRY WASTE DISPOSAL

A. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Framing and supports not specified in othe Sections

1.02 RELATED REQUIREMENTS

A. Section 055133 - Metal Ladders.

B. Section 09960 - High Performance Coatings

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

E. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

F. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

H. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

I. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.

J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

K. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

M. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Plates: ASTM A36/A36M.

B. Steel Shapes: ASTM A992/A992M

C. Steel Angles: ASTM A572/A572M

D. Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.

E. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

F. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.

G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Lintels: As detailed; galvanized finish.

B. Hoistway Beams: Beam sections; Galvanized and painted finish.

2.04 FINISHES - STEEL

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

C. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055000

SECTION 055133
METAL LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop-fabricated metal ladders.

1.02 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders; Current Edition.

B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

F. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.

G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

H. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

J. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

C. Bolts, Nuts, and Washers: ASTM A307, plain.

D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED LADDERS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; galvanized finish.

2.04 FINISHES - STEEL

A. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

B. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.05 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on shop drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055133

SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood blocking and nailers.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

   1. Factory mark each piece of lumber with grade stamp of grading agency.

B. Maximum Moisture Content:

   1. Boards: 19 percent.
   2. Dimension Lumber: 19 percent.

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b for exterior construction not in contact with ground.

   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

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

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings**.**

2.3 MISCELLANEOUS LUMBER

A. 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.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

2.4 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

2.5 METAL FRAMING ANCHORS

A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

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 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

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

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

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

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

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

END OF SECTION

SECTION 06641
PLASTIC GUARD POST SHIELDS

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:

B. Plastic guard post covers.Related Requirements:

1. Section 055000 "Metal Fabrications" for guard posts.

1.3 COORDINATION

A. Coordinate sizes of plastic guard post covers with steel guard post diameters and lengths.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
1. Plastic guard post covers.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify size and projection above grade of all guard posts receiving covers.

PART 2 - PRODUCTS

2.1 PLASTIC GUARD POST COVERS

A. Plastic guard post covers to comply with the following requirements:

1. Style: Smooth surface, dome top.
2. Construction: Single-piece.
3. Material: Polyethylene thermoplastic (HDPE).
4. Nominal thickness: 0.250-inch.
5. Diameter: Coordinate with steel guard posts.
6. Height: Field verify to coordinate with steel guard posts.

7. Color: OSHA/Safety yellow.

2.2 MISCELLANEOUS MATERIALS

A. Neoprene adhesive or foam tape: As recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting and fitting required for installing plastic guard post covers.

B. Install per manufacturer’s recommendations using neoprene adhesive tape of foam tape.

C. Do not install damaged or broken covers.

END OF SECTION

SECTION 07132
SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.
2. Protection course.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

B. Sample warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Waterproofing System: Obtain waterproofing materials and protection course from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet Waterproofing: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.
   1. Physical Properties:
      a. Tensile Strength, Membrane: 250 psi minimum; ASTM D412, Die C, modified.
      b. Ultimate Elongation: 300 percent minimum; ASTM D412, Die C, modified.
      c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
      d. Puncture Resistance: 40 lbf minimum; ASTM E154/E154M.
      e. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
      f. Water Vapor Permeance: 0.05 perm maximum; ASTM E96/E96M, Water Method.

2.3 ACCESSORIES FOR WATERPROOFING

A. Furnish accessory materials as recommended in writing by waterproofing manufacturer for intended use and compatibility with sheet waterproofing.
   1. Furnish liquid-type accessory materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer as recommended in writing for substrate by sheet waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner as recommended in writing for substrate by sheet waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Aluminum or stainless steel bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

2.4 PROTECTION COURSE

A. Protection Course, Asphaltic: ASTM D6506/D6506M; semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

1. Thickness: Nominal 1/4 inch.
2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

B. Protection Course, Extruded-Polystyrene Board Insulation, Faced: Fan folded, faced on one side or both sides with plastic film, nominal thickness 1/4 inch, with compressive strength of not less than 8 psi when tested in accordance with ASTM D1621, and maximum water absorption by volume of 0.6 percent when tested in accordance with ASTM C272/C272M.

C. Protection Course, Extruded-Polystyrene Board Insulation, Unfaced: ASTM C578, Type X, 1/2 inch thick.

D. Protection Course, Molded-Polystyrene Board Insulation: ASTM C578, Type I, 0.90 lb/cu. ft. minimum density, 1-inch minimum thickness.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean, prepare, and treat substrates in accordance with manufacturer's written installation instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.2 INSTALLATION OF MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Install modified bituminous sheets in accordance with waterproofing manufacturer's written installation instructions.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.

E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

F. Seal edges of sheet waterproofing terminations.

G. Install sheet waterproofing and accessory materials to tie into adjacent waterproofing.

H. Roll waterproofing membrane to firmly adhere to substrate. Roll seams and terminations.

I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

J. Immediately install protection course with butted joints over waterproofing membrane.

3.3 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

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

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 07210
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.

1.2 ACTION SUBMITTALS

A. Product data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than Class A, 25 and 450 when tested in accordance with ASTM E84.

B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (XPS)

A. Extruded Polystyrene Board Insulation, Type X: ASTM C578, Type X, 15 psi minimum compressive strength; unfaced.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

B. Miscellaneous Application Accessories:

1. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
2. Crack Sealer: Closed-cell insulating foam in aerosol dispenser recommended in writing by insulation manufacturer for filling gaps in board insulation.
3. Detailing Foam Insulation for Voids: Urethane foam complying with AAMA 812, low expansion pressure suitable for filling insulation gaps and voids adjacent to openings to protect against water, air, and sound intrusion.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

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

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive in accordance with manufacturer's written instructions.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing in accordance with manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended in writing by manufacturer.

1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.
3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.6 INSTALLATION OF BOARD INSULATION

A. Install board insulation in accordance with manufacturer's written instructions per project applications and conditions.

B. Install interior radiation control coating system in accordance with ASTM C1321.

3.7 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07272
FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vapor-retarding, fluid-applied air barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air-barrier assemblies.

1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to

discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested in accordance with ASTM E2357.

C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference; ASTM E2178.

D. Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.

E. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested in accordance with ASTM D4541.

F. UV Resistance: Can be exposed to sunlight for 90 days in accordance with manufacturer's written instructions.

2.2 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

A. High-Build, Vapor-Retarding Air Barrier Modified Bituminous Type: Modified bituminous membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.

B. Vapor Permeance: Maximum 0.1 perm; ASTM E96/E96M, Procedure A, Desiccant Method.

2.3 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

3.2 INSTALLATION

A. Install materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames.

D. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

E. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in two equal coats.

F. Do not cover air barrier until it has been tested and inspected by testing agency.

G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.

B. Remove masking materials after installation.

END OF SECTION

SECTION 07532
ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories.
5. Asphalt materials.
6. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preliminary Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness if insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Tie-in with air barrier.

C. Samples: For the following products:

1. Roof membrane and flashings of color required.
2. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Field Test Reports:

1. Concrete internal relative humidity test reports.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.
2. Installers: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 30 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane to resist impact damage when tested in accordance with ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested in accordance with FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As indicated on drawings.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60.
2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.

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

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

A. EPDM Sheet: ASTM D4637/D4637M, Type I, nonreinforced, EPDM sheet.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carlisle SynTec Incorporated.
2. Holcim Elevate
3. GenFlex Roofing Systems.
4. Johns Manville.
5. Versico Incorporated.

C. Thickness: 90 mils, nominal.

D. Exposed Face Color: White on black.

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.

C. Slip Sheet: Manufacturer's standard, of thickness required for application.

D. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

E. Bonding Adhesive: Manufacturer's standard.

F. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch-wide minimum, butyl splice tape with release film.

G. Lap Sealant: Manufacturer's standard, single-component sealant.

H. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

I. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.

K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

1. Provide white flashing accessories for white EPDM membrane roofing.

2.4 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1 felt facer on both major surfaces.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carlisle SynTec Incorporated.
   b. Holcim Elevate.
   c. GAF Materials Corporation.
   d. Insulfoam LLC; a Carlisle company.
   e. Johns Manville.
2. Size: 48 by 48 inches.
3. Thickness:
   a. Base Layer: 1-1/2 inches.
   b. Upper Layer: As required to meet R-30 value.

B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

    a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES AND COVER BOARD

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
    1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

    1. Size: Approximately 36 by 60 inches.
    2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

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

    1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
    2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer when tested in accordance with ASTM F2170.

        a. Test Frequency: One test probe per each 1000 sq. ft., or portion thereof, of roof deck, with not less than three test probes.
        b. Submit test reports within 24 hours of performing tests.

    3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
    4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system in accordance with roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072726 "Fluid-Applied Membrane Air Barriers."

3.3 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
    a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    b. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    c. Fill gaps exceeding 1/4 inch with insulation.
    d. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    e. Loosely lay base layer of insulation units over substrate.
    f. Adhere base layer of insulation to vapor retarder in accordance with FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
        1) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
    a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    d. Fill gaps exceeding 1/4 inch with insulation.
    e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

f. Adhere each layer of insulation to substrate using adhesive in accordance with FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
   1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.4 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing in accordance with roofing system manufacturer's written instructions.

B. Unroll membrane roof membrane and allow to relax before installing.

C. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

E. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.

F. Apply roof membrane with side laps shingled with slope of roof deck where possible.

G. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.
3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

3.5 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates in accordance with roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 INSTALLATION OF WALKWAYS

A. Flexible Walkways: Install walkway products in accordance with manufacturer's written instructions.

1. Install flexible walkways at the following locations:
   a. Locations indicated on Drawings.

2. Provide 6-inch clearance between adjoining pads.
3. Adhere walkway products to substrate with compatible adhesive in accordance with roofing system manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

3.8 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07600
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Metal counter flashing and base flashing (if any).
   2. Metal wall flashing and expansion joints.
   3. Miscellaneous sheet metal accessories.

B. Related Documents: Drawings and general provisions of Contract, including General Conditions and Division 1 Specification Sections, apply to Work of this Section.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Manufacturer's technical product data, installation instructions, and general recommendations for each specified sheet material and fabricated product
   2. Samples of the following flashing, sheet metal, and accessory items:
      a. 8-inch square samples of specified sheet materials to be exposed as finished surfaces.
      b. 12-inch-long samples of factory-fabricated products exposed as finished Work. Provide complete with specified factory finish.

1.03 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of Work and protection of materials and finishes.

PART 2 - PRODUCTS

2.01 SHEET METAL FLASHING AND TRIM MATERIALS

A. Zinc-Coated Steel: Commercial quality with 0.20 percent copper, ASTM A 526, except ASTM A 527 for lock-forming, G90 hot-dip galvanized, mill phosphatized where indicated for painting, 0.0359-inch thick (20 gauge) except as otherwise indicated.

B. Aluminum: ASTM B 209, Alloy 3003, temper H14, AA-C22A41 clear anodized finish, 0.032-inch thick (20 gauge) except as otherwise indicated.

C. Extruded Aluminum: Manufacturer's standard extrusions of sizes and profiles indicated, 60063-T52, AA-C22A41 clear anodized finish, 0.080-inch minimum thickness for primary legs of extrusions.

D. Minimum Gauges and Thicknesses for Flashings and Sheet Metal Work

Application	USS Gauge	Thickness in Inches
Downspouts		
Aluminum		0.032
Galvanized Steel	26	
Gutters		
Aluminum		0.032
Galvanized Steel	26	
Gutter Straps		
Aluminum		1/4 by 2
Galvanized Steel		1/4 by 1-1/2
Counter and Base Flashings		
Aluminum		0.032
Galvanized Steel	26	

E. See Standard Details on Drawings for additional information.

2.02 FLEXIBLE SHEET MEMBRANE FLASHING

A. Elastic Sheet Flashing/Membrane: Nonreinforced, flexible black elastic sheet flashing of 50 to 65 mils thickness and complying with the following:
   1. Shore A Hardness (ASTM D 2240): 50 to 70.
   2. Tensile Strength (ASTM D 412): 1,200 psi.
   3. Tear Resistance (ASTM D 624, Die C): 20 pounds per linear inch.
   4. Ultimate elongation (ASTM D 412): 250 percent.
   5. Low temperature brittleness (ASTM D 746): minus 30 degrees F (minus 35 degrees C).
   6. Resistance to ozone aging (ASTM D 1149): no cracks for 10 percent elongated sample for 100 hours in 50 pphm (50.5 mPa) ozone at 104 degrees F (70 degrees C).
   7. Resistance to Heat Aging (ASTM D 573): maximum hardness increase of 15 points, elongation reduction of 40 percent, and tensile strength reduction of 30 percent, for 70 hours at 212 degrees F (100 degrees C).

B. Acceptable Materials:
   1. Neoprene synthetic rubber sheet.
   2. Butyl synthetic rubber sheet.
   3. EPDM synthetic rubber sheet.

C. Miscellaneous Materials and Accessories:
   1. Solder: For use with steel or copper, provide 50-50 tin/lead solder (ASTM B 32), with rosin flux.
   2. Solder: For use with stainless steel, provide 60-40 tin/lead solder (ASTM B 32), with acid-chloride type flux, except use rosin flux over tinned surfaces.
   3. Fasteners: Same metal as flashing/sheet metal or other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.
   4. Bituminous Coating: SSPC - Paint 12, solvent type bituminous mastic nominally free of sulfur, compounded for 15 mil dry film thickness per coat.
   5. Mastic Sealant: Polyisobutylene, nonhardening, nonskinning, nondrying, nonmigrating sealant.

D. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07900.

E. Epoxy Seam Sealer: Two-part noncorrosive metal seam cementing compound recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.

F. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.

G. Paper Slip Sheet: 5-pound rosin-sized building paper.

H. Polyethylene Underlayment: Minimum 6-mil carbonated polyethylene film; resistant to decay when tested in accordance with ASTM E 154.

I. Reglets: Metal or plastic units of type and profile indicated, compatible with flashing indicated, noncorrosive.

J. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed, noncorrosive, size and gauge required for performance.

K. Cast Iron Drainage Boots: Gray iron castings of size and pattern indicated, ASTM A 48, bituminous shop-coated.

L. Roofing Cement: ASTM D 2822, asphaltic.

2.03 FABRICATED UNITS

A. General Metal Fabrication: Shop-fabricate Work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA Architectural Sheet Metal Manual, and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running Work, sufficient to permanently prevent leakage, damage, or deterioration of Work. Form Work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal Work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

B. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. For metal other than aluminum, tin edges to be seamed, form seams, and solder. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.

C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in Work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with mastic sealant (concealed within joints).

D. Sealant Joints: Where movable, nonexpansion type joints are indicated or required for proper performance of Work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.

E. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

F. Aluminum Extrusion Units: Fabricate extruded aluminum running units with formed or extruded aluminum joint covers for installation behind main members where possible. Fabricate mitered and welded corner units.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual. Anchor units of work securely in place by methods indicated, 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 which will be permanently watertight and weatherproof.

B. 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.

C. Bed flanges of Work in a thick coat of bituminous roofing cement where required for waterproof performance.

D. Install reglets to receive counterflashing in manner and by methods indicated.
   1. Where shown in concrete, furnish reglets to trades of concrete work for installation as Work of Division 3.
   2. Where shown in masonry, furnish reglets to trades of masonry work, for installation as Work of Division 4.
   3. Install counterflashing in reglets either by snap-in seal arrangement or by welding in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.

E. Nail flanges of expansion joint units to curb nailers at maximum spacing of 6 inches on center. Fabricate seams at joints between units with minimum 3-inch overlap to form a continuous, waterproof system.

3.02 CLEANING AND PROTECTION

A. Clean exposed metal surfaces removing substances which might cause corrosion of metal or deterioration of finishes.

B. Protection: Advise CONTRACTOR of required procedures for surveillance and protection of flashings and sheet metal Work during construction to ensure that Work will be without damage or deterioration, other than natural weathering, at time of Substantial Completion.

END OF SECTION

SECTION 07710
ROOF SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Copings.
   2. Roof-edge drainage systems.

B. Preinstallation Conference: Conduct conference at Project site.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roof specialties.
   1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

C. Samples: For each type of roof specialty and for each color and texture specified.

1.03 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by a qualified testing agency.

B. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.

1.06 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. FM Approvals' Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

B. SPRI Wind Design Standard: Manufacture and install copings tested in accordance with SPRI ES-1 and capable of resisting the following design pressures:
   1. Design Pressure: As indicated on Drawings.

C. 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.

2.02 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
   1. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.040 inch thick.
      a. Surface: Smooth, flat finish.
      b. Finish: Three-coat fluoropolymer.
      c. Color: As selected by Architect from manufacturer's full range.
   2. Corners: Factory mitered and soldered.
   3. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.
      a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.

2.03 ROOF-EDGE DRAINAGE SYSTEMS

A. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
   1. Aluminum Sheet: 0.040 inch thick.
   2. Gutter Profile: Style A in accordance with SMACNA's "Architectural Sheet Metal Manual."
   3. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
   4. Gutter Accessories: Wire ball downspout strainer.

B. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
   1. Formed Aluminum: 0.040 inch thick.

C. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof.
   1. Formed Aluminum: 0.032 inch thick.

D. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout.
   1. Formed Aluminum: 0.032 inch thick.

E. Aluminum Finish: Three-coat fluoropolymer.
   1. Color: As selected by Architect from manufacturer's full range.

2.04 MATERIALS

A. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

2.05 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
   1. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F.
   2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F.

B. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

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

2.06 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
   1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
   2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.07 FINISHES

A. Coil-Coated Aluminum Sheet Finishes:
   1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat.

PART 3 - EXECUTION

3.01 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
   1. Apply continuously under copings.
   2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.02 INSTALLATION, GENERAL

A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
   1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
   2. Provide uniform, neat seams with minimum exposure of solder and sealant.
   3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
   4. Torch cutting of roof specialties is not permitted.
   5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
   1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
   2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.03 INSTALLATION OF COPINGS

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
   1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.04 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

A. Install components to produce a complete roof-edge drainage system in accordance with manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
   1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
   1. Connect downspouts to underground drainage system indicated.

D. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

E. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch below scupper discharge.

3.05 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION

SECTION 07720
ROOF ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Roof curbs.
2. Equipment supports.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

B. Shop Drawings: For roof accessories.

C. Samples: For each exposed product and for each color and texture specified.

1.03 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.05 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.
1. Finish: Mill phosphatized.

D. Construction:
   1. Curb Profile: Manufacturer's standard compatible with roofing system.
   2. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
   3. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
   4. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
   5. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
   6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
   7. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
   8. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.02 EQUIPMENT SUPPORTS

A. Equipment Supports: Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, and integrally formed structure-mounting flange at bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.
   1. Finish: Mill phosphatized.

D. Construction:
   1. Curb Profile: Manufacturer's standard compatible with roofing system.
   2. Nailer: Factory-installed continuous wood nailers 3-1/2 inches wide under top flange on side of curb, continuous around support perimeter.
   3. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
   4. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
   5. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
   6. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
   7. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.
   8. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.03 METAL MATERIALS

A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 coated.
   1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
   2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Sheet: ASTM B209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
   1. Mill Finish: As manufactured.
   2. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
   3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

2.04 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Cellulosic-Fiber Board Insulation: ASTM C208, Type II, Grade 1, thickness as indicated.

C. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.

D. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

F. Underlayment:
   1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
   2. Polyethylene Sheet: 6-mil-thick polyethylene sheet complying with ASTM D4397.
   3. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
   4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt

adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

G. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

H. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

I. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

J. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

K. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.02 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07841
THROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1.03 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

B. Product test reports.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
1. Penetration firestopping tests are performed by UL.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified testing and inspection agency.

C. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated-Design Submittal: Design through-penetration firestop systems, using performance requirements and design criteria indicated For through-penetration firestop systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional ENGINEER responsible for their preparation.

2.02 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   1. A/D Fire Protection Systems Inc.
   2. Grace Construction Products.
   3. Hilti, Inc.
   4. Nelson Firestop Products.
   5. Passive Fire Protection Partners.
   6. RectorSeal Corporation.
   7. 3M Fire Protection Products.
   8. Tremco, Inc.; Tremco Fire Protection Systems Group.

2.03 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
   1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
   1. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
   2. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

F. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

G. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration

firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

D. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

E. At annular areas around pipes that are periodically replaced, provide firestopping design and materials that can be removed and replaced. Confirm locations with Owner.

3.02 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.03 FIELD QUALITY CONTROL

A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Perform under this section patching and repairing or firestopping caused by cutting or penetration by other trades.

END OF SECTION

SECTION 07920
JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.

B. Related Requirements:

1.02 ACTION SUBMITTALS

A. Product Data:

1. Joint-sealants.
2. Joint sealant backing materials.

B. Samples for Initial Selection: Manufacturer's standard 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-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.03 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

a. Joint-sealant location and designation.
b. Manufacturer and product name.
c. Type of substrate material.
d. Proposed test.
e. Number of samples required.

B. Sample warranties.

1.04 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.
2. Installer's special warranties.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Authorized representative who is trained and approved by manufacturer.
2. Testing Agency: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.06 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.07 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer.

2.02 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.03 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

B. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

C. Silicone, S, NS, 35, NT: Single-component, nonsag, plus 35 percent and minus 35 percent movement capability. nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT.

D. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

E. Silicone, Acid Curing, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT.

F. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

G. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T and NT.

H. Silicone, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

I. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.

J. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

K. Silicone, M, P, 100/50, T, NT: Multicomponent, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade P, Class 100/50, Uses T and NT.

2.04 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

C. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

D. Urethane, S, P, 35, T, NT: Single-component, pourable, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 35, Uses T and NT.

E. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

F. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.

G. Urethane, M, NS, 25, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Use NT.

H. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T and NT.

I. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT.

J. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 50, Uses T and NT.

K. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

2.05 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin)] [Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.06 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

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

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 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 C1193 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 in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.04 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.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 08220
FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Section includes fiberglass reinforced plastic (FRP) doors and frames.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM) Specifications.

1. A 123 Zinc Coatings.
2. C 591-01 Unfaced Preformed Rigid Cellular Polyisocyanurate.
3. C 728-97 Insulation Board, Mineral Aggregate.
4. E 330-97 Structural Load Test.
5. E 1996 Wind Load Test.
6. E 1886 Impact Test Procedures (inclusive of Large Missile Impact).

C. Door and Frame Preparation for Hardware, American National Standard Institute Specifications (ANSI).

D. Recommended Locations for Builder's Hardware, Door and Hardware Institute (DHI).

1.03 PERFORMANCE REQUIREMENTS

A. Exterior FRP doors shall be designed to meet wind-loading requirements of the Michigan Building Code (MBC). Refer to Structural Drawings for wind and design pressures.

1.04 SUBMITTALS

A. Submit in accordance with Division 1. Include copies of manufacturer's specifications for fabrication and installation including certifications, data and test reports substantiating that products comply with requirements.

B. Submit shop drawings showing sizes and complete details of doors. Include details of core and edge construction, trim for openings and similar components. Include finishing specifications for doors to receive factory-applied shop finish.

B. Provide a schedule of doors and frames using same reference designations for details and openings as indicated on the Contract Drawings.

C. Samples: Submit manufacturer's door sample composed of door face sheet, core, framing and finish.

D. Color samples: Submit manufacturer's sample of standard colors for door face and frame

E. Certified test reports indicating the acoustical performance of the door meets or exceeds the Sound Transmission Class (STC) performance stated in One-Third Octave Band Transmission Loss performance shown in the Acoustical Performance Schedule below. Test data shall be produced from an accredited independent acoustical laboratory which is a member of NVLAP (National Volunteer Laboratory Accreditation Program). Reports should indicate that the test was performed on the doors and frames of the type to be supplied in conformance with the requirements of test method ASTM Standard E90-02 (or more recent), Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitionsand Elements

E. Furnish to the Owner an Owners Operation and Maintenance Manual in accordance with Division 1. The manual shall consist of maintenance instructions for doors and frames; catalog pages for each product; name, address and phone number of the local representative of each manufacturer; and copy of the approved shop drawings.

1.05 PRODUCT HANDLING

A. Doors are to be stacked flat in a dry and protected area in original cartons prior to installation. Provide blocking or staging to protect door surfaces. Do not drag doors across one another. Lift doors and carry them into position. Identify each door with individual opening designations, as indicated on the approved shop drawings, using concealed markings.

1.06 WARRANTY

A. Submit written agreement in door manufacturer's standard form signed by manufacturer, Installer and Contractor, agreeing to repair or replace defective doors which have separated, delaminated from the core, expansion of the core, or otherwise failed due to defects in material and workmanship, improper installation or corrosion from a specified environment, for a period of not less than ten (10) years.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Special-Lite, Inc., Decatur, Michigan – Model AF-100 (Basis of Design Product).

2. Tiger Door, LLC.

2.02 FIBERGLASS REINFORCED PLASTIC (FRP) DOORS

A. FRP Door Construction: Pultruded as one monolithic panel with integral stiles:

1. Door Thickness: 1-3/4".

3. Stiles: Seamless 9/16" thick solid FRP.

4. Top Rail: 6" pultruded tube profile designed to fit flush and be chemically welded inside of door cavity.

5. Bottom Rail: Standard pultruded inverted U channel designed to fit flush and be chemically welded inside the door which allows doors to be field trimmed.

6. Core: Polyurethane foam, minimum 6 pcf density.

7. Face Sheet: Smooth, pultruded FRP integral to construction of door. Door to be pultruded as one monolithic panel.

8. Cutouts: Manufacture doors with cutouts for required vision lites, louvers, and panels.

9. Hardware: Pre-machine doors in accordance with templates from specified hardware manufacturers. Surface mounted closures will be reinforced for but not prepped or installed at factory.

10. Reinforcements: No metallic reinforcements will be allowed.

2.03 FRP FRAMES

A. ¼" thick pultruded fiberglass open throat with return, factory fabricated, with 2" face.
B. Integral Door Stops: 5/8" x 2-1/4".
C. Frame Assembly: Standard knock down.

D. Frame Member to Member Connections: Corners mitered with 4” x 4” x 3/8” pultruded FRP angle reinforcement with interlocking pultruded FRP brackets. All member to member connections knocked down at factory unless chemically welded at factory requested. Provide hairline butt joint appearance.

E. Reinforcements: ¼” thick pultruded FRP chemically welded to frame at all hinge, strike, and closer locations.

2.04 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.

1. Do not use exposed fasteners.

B. Brackets and Reinforcements: Manufacturer’s high strength aluminum units where feasible, otherwise nonferrous stainless steel.

C. Bituminous Coating: Cold applied asphaltic mastic, compounded for 30 mil thickness per coat.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify upon delivery that all doors and frames comply with the approved shop drawings and meet the indicated requirements for type, size, location and swing. Examine each opening for conditions that would prevent the proper application of doors, frames and related items. Do not proceed until defects are corrected.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer’s instructions and approved shop drawings; set frames plumb, square, level, and aligned to receive doors.

B. Anchor frames to adjacent construction in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer’s instructions.

1. Seal metal-to-metal joints between framing members using good quality elastomeric sealant.

D. Hang doors with required clearances as follows:

1. Hinge and Lock Stiles: 0.125 inch.

2. Between Meeting Stiles: 0.250 inch.

3. At Top Rails: 0.125 inch.

4. Between Door Bottom and Threshold: 0.125 inch.

E. Adjust doors and hardware to operate properly.

F. Install hardware for doors of this section.

G. Installation of door hardware is specified in Section 08710.

3.03 CLEANING

A. Upon completion of installation thoroughly clean door and frame surface in accordance with AAMA 609.

B. Do not use abrasive, caustic or acid cleaning agents.

3.04 PROTECTION

A. Protect products of this section from damage caused by subsequent construction until substantial completion.

B. Repair damage or defect products to original specified condition in accordance with manufacturer's recommendations.

C. Replace damaged or defective products that cannot be repaired to the Architect's acceptance.

END OF SECTION

SECTION 08710
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.

B. 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 80 - Fire Doors and Windows.
4. NFPA 101 - Life Safety Code.
5. NFPA 105 - Installation of Smoke Door Assemblies.
6. Michigan State Building Code, Local Amendments.

C. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

    a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

E. 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. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Hinges.
2. Exit devices and auxiliary items.
3. Lock cylinders.
4. Construction cores.
5. Keying system/keys.
6. Operating trim.
7. Surface closers.
8. Wall- and floor-mounted stops.
9. Door gasketing.
10. Thresholds.
11. Metal protective trim units.

B. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule.

1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.

C. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
2. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
e. Fastenings and other pertinent information.
f. Explanation of abbreviations, symbols, and codes contained in schedule.
g. Mounting locations for door hardware.

D. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Architectural Hardware Consultant.

B. Product Certificates: For electrified door hardware, from the manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

B. Warranty: Executed special warranty specified in this Section.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:

1. For door hardware, an Architectural Hardware Consultant (AHC).

C. Source Limitations: Obtain each type of door hardware from a single manufacturer.

D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

F. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

G. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC/ANSI A117.1 and building code in effect for Project.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

H. Pre-installation Conference: Conduct conference at Project site.

1. Inspect and discuss preparatory work performed by other trades.
2. Inspect and discuss electrical roughing-in for electrified door hardware.
3. Review sequence of operation for each type of electrified door hardware.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.9 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

a. Exit Devices: Two years from date of Substantial Completion.
b. Manual Closers: 10 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products or products equivalent in function and comparable in quality to named products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Electric Locking Hardware: Exit hardware shall always remain fully operational manually regardless of the status of electric latch.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:

a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
   1) Out-swinging exterior doors.
   2) Out-swinging access controlled doors.
   3) Out-swinging lockable doors.

5. Acceptable Manufacturers:

   a. Hager Companies (HA).
   b. McKinney Products (MK).

2.3 CONTINUOUS HINGES

A. Continuous, Gear-Type Hinges: ANSI/BHMA A156.26; minimum 0.120-inch- thick, extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings. Minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hager Companies.
   b. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.

2.4 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified below or 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.

   a. Acceptable Manufacturers:
      1) Rockwood Manufacturing (RO).

2) Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years' experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.

2. 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.

3. Keyway: Match Facility Standard.

D. Keying System: Match existing key system or provide new patented cylinder listed in 2.4.D. Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:

1. Existing System: Grand master key locks to Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Top Master Key: One (1)
2. Change Keys per Cylinder: Two (2)
3. Master Keys (per Master Key Group): Two (2)
4. Grand Master Keys (per Grand Master Key Group): Two (2)
5. Construction Keys (where required): Ten (10)
6. Construction Control Keys (where required): Two (2)
7. Permanent Control Keys (where required): Two (2)

F. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

G. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

2.6 MECHANICAL LOCKS AND LATCHES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.

1. Subject to compliance with requirements, products are limited to the following:

    a. Schlage L Series

B. Lock Trim Design: Schlage Elan.

C. Lock Functions: As indicated in door hardware schedule.

D. Lock Backset: 2-3/4 inches, unless otherwise indicated.

E. Lock Trim:

1. Levers:

    a. Schlage Elan.

F. 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.

G. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Auxiliary Deadlocks: BHMA A156.5.

2.7 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. SFIC (small format interchangeable cylinder), 7 pin

1. Manufacturers: Subject to compliance with requirements, products are limited to the following:

    a. Schlage.

B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 3 construction master keys.

2.8 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

1. Master Key System: Change keys and a master key operate cylinders.
2. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
3. Existing System:

    a. Master key or grand master key locks to Owner's existing system.
    b. Re-key Owner's existing master key system into new keying system.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

    a. Notation: "DO NOT DUPLICATE."

2. Quantity: In addition to one extra key blank for each lock, provide the following:

    a. Cylinder Change Keys: Three.
    b. Master Keys: Five.
    c. Grand Master Keys: Five.

2.9 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel, 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. Forms + Surfaces.
    b. Hager Companies.
    c. IVES Hardware; an Ingersoll-Rand company.
    d. Rockwood Manufacturing Company.

2.10 SURFACE 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 and UBC 7-2 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.

    a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
    b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
    c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
    d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door 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) - DC8000 Series.
    b. LCN Closers (LC) - 4040XP Series.

c. Sargent Manufacturing (SA) - 351 Series.
d. Norton Door Controls (NO) - 7500 Series.
e. Yale Locks and Hardware (YA) - 4400 Series.

2.11 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:

a. Rockwood Manufacturing (RO).
b. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Acceptable Manufacturers:

a. Rixson Door Controls (RF).
b. Sargent Manufacturing (SA).

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. **All seals and weatherstrip seals to be mechanically fastened to the frame; adhesive fastening is not allowed.**

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.

C. Acceptable Manufacturers:

1. Pemko Manufacturing (PE).
2. Reese Enterprises, Inc. (RS).
3. Zero International (ZE).

2.13 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hager Companies.
b. IVES Hardware; an Ingersoll-Rand company.
c. Rockwood Manufacturing Company.

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

a. Wood or Machine Screws: For the following:
1) Hinges mortised to doors or frames
2) Strike plates to frames.
3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:
1) Surface hinges to doors.
2) Closers to doors and frames.
3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors.
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

A. Provide finishes complying with BHMA A156.18 matching finish of existing hardware.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

D. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
3. 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."

D. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.7 DOOR HARDWARE SCHEDULE

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. AD - Adams Rite
2. GJ – Glynn Johnson
3. IV – Ives
4. JN - Johnson
5. MK - McKinney
6. NG – National Guard Products
7. NO - Norton
8. PE - Pemko
9. RF - Rixson
10. RO - Rockwood
11. SA – Sargent
12. SC - Schlage
13. SU - Securitron
14. YA - Yale

C. HARDWARE SCHEDULE

Door 101

2 Ea	Continuous Hinge	FM	C	PE
1 Ea	Parallel Arm Closer with Heavy-Duty Arm, Cushion Stop, and Hold-Open	CPS 7500	689	NO
1 Ea	Medium Duty Overhead Door Holder/Holdopen/Stop	450 Series	US32D	GJ
1 Pair	Surface Bolts	SB360	604	IV
1 Ea	Mortise Lockset – Storeroom Function	L Series	630	SC
1 Ea	Cylinder			GJ
2 Ea	Sweep	308	CxBL	PE
1 Ea	Threshold	651	A	PE
1 Set	Weatherstrip	303	BSP x BL	PE

1 Ea	Astragal	375 Series	BSP	PE
1 Ea	Drip Cap			

Doors 102, 103

1 Ea	Continuous Hinge	FM	C	PE
1 Ea	Parallel Arm Closer with Heavy-Duty Arm, Cushion Stop	CPS 7500	689	NO
1 Ea	Mortise Lockset – Storeroom Function	L Series	630	SC
1 Ea	Cylinder			
1 Ea	Sweep	308	CxBL	PE
1 Ea	Threshold	651	A	PE
1 Set	Weatherstrip	303	BSP x BL	PE
1 Ea	Drip Cap			

END OF SECTION

SECTION 09960
HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems**.** on the following substrates:
   1. Interior Substrates:

      a. Concrete, horizontal surfaces.
      b. Concrete masonry units (CMUs).
      c. Steel.
      d. Galvanized metal.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. PPG Paints; PPG Industries, Inc.

2.02 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
   3. Products shall be of same manufacturer for each coat in a coating system.

B. Colors: As selected from manufacturer’s full range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Clean existing galvanized and/or painted metal surfaces in accordance with SSPC 11.

C. New concrete must cure a minimum of 28 days prior to application of any coatings. Bare concrete must be clean, dry and free of contaminates such as dirt, dust, grease, oil and other foreign materials. A suitable moisture barrier must be in place for concrete slabs on-grade. If a moisture vapor barrier is not in place, seasonal variations in ground moisture can cause excessive hydrostatic pressure regardless of results measured prior to coating application. Concrete should be shot blasted or diamond ground to a surface profile CSP 2 or 3.

D. PREVIOUSLY COATED CONCRETE - Old coatings and concrete must be in sound condition. Surfaces must be clean and dry and free of all contaminants such as dust, dirt, grease, and oil. Old coatings must be uniformly abraded to achieve satisfactory adhesion. Apply a test patch to the abraded surface and allow to cure a minimum of one week before testing adhesion. If adhesion is poor, or if the old coatings are peeling, chipping, or are otherwise in poor condition, remove the coatings down to bare concrete and prepare the bare concrete as shown above

E. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   2. Masonry (Clay and CMUs): 12 percent.

F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
   2. Shot blast concrete slab to CSP 2.0 or 3.0 profile.

3.03 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.04 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Horizontal Surfaces.
   1. Epoxy, High-Build System:
      a. Prime Coat: PPG Flooring Concrete Epoxy Primer
         1) Two component.
         2) 100% Solids.
         3) Low viscosity.
         4) VOC: 0.0 lbs/gal (0.0 g/ltr), per EPA Method 24.
         5) Dry film thickness: 3.2 – 8.0 mils.
      b. Intermediate Coat: PPG Flooring Self-Leveling Epoxy.
         1) Two component.
         2) 100% solids.
         3) Self-leveling.
         4) VOC: 0.0 lbs/gal (0.0 g/ltr), per EPA Method 24.
         5) High gloss.
         6) Dry film thickness: 20.0 mils.
      c. Striping: Amerlock 2 Safety Yellow surface tolerant epoxy
         1) 5.0 to 10.0 dry film thickness.
      d. Topcoat: PPG Flooring High Performance Wear-Resistant Urethane.
         1) Three component.
         2) 92% +/- 2% solids by volume.
         3) VOC: 0.8 lb/gal (95 g/ltr) per EPS Method 24.
         4) Clear.
         5) Satin finish.

B. CMU Substrates:

   1. Epoxy System MPI INT 4.2F:

      a. Block Filler: Block filler, epoxy, MPI #116.

      b. Intermediate Coat: Epoxy, matching topcoat.
      c. Topcoat: Epoxy, gloss, MPI #77.

C. Steel Substrates:

   1. Epoxy System MPI INT 5.1L:

      a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

      b. Intermediate Coat: Epoxy, matching topcoat.
      c. Topcoat: Epoxy, gloss, MPI #77.

D. Galvanized-Metal Substrates:

1. Epoxy over Epoxy Primer System MPI INT 5.3D:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, gloss, MPI #77.

END OF SECTION

SECTION 13410 - BASIC INSTRUMENTATION REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: General administrative and procedural requirements for instrumentation installations. Administrative and procedural requirements are included in this Section to expand on requirements specified in Division 1.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Sections 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product data for each product specified.
   2. Wiring diagrams, both elementary and schematic, differentiating between manufacturer installed and field-installed wiring.
   3. Digital Systems: Provide the following:
      a. Digital equipment layouts of input and output racks showing complete module model number and addressing assignment. Layouts of port pin assignment, connection schematic indicating cable types and port addresses.

B. Record Drawings: At Project closeout, submit record drawings of installed products, in accordance with requirements of Section 01770.
   1. Electronic Drawings shall be in AutoCad. Where Drawings are drafted by computer equipment, CONTRACTOR shall furnish files on a thumb drive. These Drawings shall include changes made by Field Orders, Change Orders, Addenda, and errors discovered during start-up and acceptance.
   2. Drawings shall include terminal numbers at each wiring termination and piping termination. A complete system diagram shall be included.

C. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01600, operation and maintenance manuals for items included under this Section.
   1. Instructions shall be short, easy-to-understand directions specifically written for this Project describing various possible methods of operating equipment. Instructions shall include procedures for tests required, adjustments to be made, and safety precautions to be taken with equipment. These documents are to be submitted to ENGINEER's office.
   2. Provide 2 complete sets of manufacturer's documentation covering programmable equipment supplied. Include hardware manuals and prints as manufacturer normally ships with programmable equipment.
   3. A complete copy of all operation and maintenance documentation shall be provided in Adobe Acrobat and Microsoft Word on a thumb drive.

D. Warranty: Submit in accordance with requirements of Section 01770, warranties covering the items included under this Section.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:
   1. National Electric Code.
   2. Applicable State and local requirements.
   3. UL listing and labeling shall be adhered to.

C. Equipment that does not have a UL, FM, CSA, or other listed testing laboratory label shall be furnished with a notarized letter signed by the supplier stating that equipment furnished has been manufactured in accordance with National Electric Code and OSHA requirements.

D. CONTRACTOR shall provide permits and licenses, observe and abide by applicable laws, regulations, ordinances, and rules of State, territory or political subdivision thereof, wherein the Work is done. CONTRACTOR shall pay fees for permits, inspections, licenses, and certifications when such fees are required.

E. Responsibility and Coordination: Drawings and Specifications are intended to include details of a complete equipment installation for purposes specified. CONTRACTOR shall be responsible for details which may be necessary to properly install, adjust, and place in operation complete installation. Any error on Drawings or in Specifications which prevents proper operation of supplied system shall be shown correct at time of Shop Drawing submittal for approval or brought to attention of ENGINEER with or prior to submittal.

F. CONTRACTOR shall be responsible for costs incurred to correct aforementioned errors brought to ENGINEER's attention. CONTRACTOR shall assume full responsibility for additional costs which may result from unauthorized deviations from Specifications.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Manufactured material shall be adequately packed to prevent damage during shipping, handling, storage, and erection. Material shipped to Site shall be packed in a container properly marked for identification. Blocks and padding shall be used to prevent movement.

B. CONTRACTOR shall inspect the material prior to removing it from carrier. If damage is observed, CONTRACTOR shall immediately notify carrier so that a claim can be made. If no such notice is given, material shall be assumed to be in undamaged condition; any subsequent damage that occurs to the equipment shall be the responsibility of CONTRACTOR. Repair and replacement of damaged parts will be done at no expense to OWNER.

C. CONTRACTOR shall be responsible for any damage charges resulting from handling of materials.

PART 2 - PRODUCTS

2.01 EQUIPMENT SUPPLIERS

A. Subject to compliance with specified requirements, equipment suppliers shall be the following (no "or equals"):
   1. West Michigan Instrumentation Systems Inc.
   2. Commerce Controls Inc.

B. References made in these Specifications to specific manufacturer’s products are intended to serve as a guide to type, construction, and materials. Listing of a manufacturer does not imply acceptance by ENGINEER of a manufacturer's particular product, product line, or latest product revision if it does not meet Specifications.

C. Equipment Supplier: Equipment specified under Sections 13413 through 13899 and shown on Drawings shall be designed as a system, fabricated or purchased, shipped to Site, and started up by one of the qualified and approved equipment suppliers listed under this Section. Intent is for unit responsibility.
   1. Equipment supplier shall not assign any of its rights or delegate any of its obligations under these Sections without prior written acceptance by ENGINEER.
   2. Direct purchase of any items in these Sections by CONTRACTOR is not in compliance with this Specification and will not be permitted.
      a. Project Engineer/Project Manager's name shall be forwarded to CONTRACTOR and ENGINEER within 30 days after receipt of a purchase order by equipment supplier.
      b. Project Engineer/Project Manager shall be focal point for design, fabrication, Contract communications, and shall be responsible for start-up and acceptance. Project Engineer/Project Manager shall be at factory test at Site for start-up and at the Site during entire acceptance procedure. Only qualified and approved equipment suppliers shall be accepted as meeting this Specification.

2.02 EQUIPMENT

A. Transmitted electronic signals to equipment of other vendors and between control panels shall be a separate isolated-floating output for each item of equipment and shall conform to ISA Standard S50.1.

B. Enclosures shall be NEMA 1, 4, 4X, or 7 as indicated on Drawings. Intrinsically safe systems, as approved by Factory Mutual, shall be furnished when called for.

C. No external power connections shall be allowed unless specifically called for in Specification. Where an external power source is called for, unit shall accept 120 VAC, plus or minus 10 percent power.

D. Current-to-current converters shall be used as power boosters to provide sufficient signal power as required. It is equipment supplier's responsibility to determine under what circumstances and locations power boosters are required, provide them, and integrate them into the instrumentation system to make system function properly.

E. Separate power supplies shall be totally enclosed with solderless terminals for connections. They shall be short circuit current limiting type that will automatically resume regulation after removal of

short circuit. They shall operate from 120 volt AC, plus or minus 10 percent power. Regulated voltage shall be fixed. Units with internal trim potentiometers will be accepted.

1. Pneumatic instruments shall have an input and output range of 3-15 psig. Units shall require a 20 psi supply. Provide an air set for each pneumatic unit or for each 20 psi manifold. Bubbler air sets, regulators, valves, etc., must be factory assembled on a subplate as specified and detailed.
2. Instruments shall be panel-mounted or enclosed for wall mounting as shown on Drawings.

F. Instruments shall be equipped with permanently attached identification tag. Tag shall be included on field- and panel-mounted devices. Tags shall include ENGINEER's tag identification and manufacturer's tag identification if different from ENGINEER's.

1. Tags shall be either stamped metal or laminated phenolic with white letters engraved on a black background. Field-mounted devices shall have tags fastened with screws. Devices mounted in panels will be tagged inside panel on subplates or on device itself where it can be easily read.

G. Finish on instruments and accessories shall provide protection against corrosion by elements in environment in which they are to be installed. Both the interior and exterior of enclosures shall be finished. Extra paint of each color used on material shall be provided by manufacturer for touch-up purposes.

H. Provide equipment identification nameplates complying with Section 16075. Nameplates shall contain ENGINEER's item designation and, for indicators and transmitters, design range and units of device shown.

2.03 SOURCE QUALITY CONTROL

A. Procesor panels, IO panels, and associated fiber control panels shall be tested at the factory prior to shipment to the Site. ENGINEER is to be given 5 weeks notice before the factory test date; ENGINEER will witness the tests. The purpose of factory testing is to verify correct functioning of equipment and conformity to Project requirements before shipment. The equipment supplier shall power up all of the panels, connect the panels with fiber optic cabling and Ethernet cabling and test all communication before Engineer begins factory test of the Owner developed PLC and SCADA application software.

B. Schedule factory test not before 8 weeks after Shop Drawing status of deliverable items under this Section is either N.E.T. or F.A.C.

C. Owner will download the PLC and application software for testing the Owner developed PLC and SCADA system programming.

D. At completion of the factory test, the panels shall remain connected for 2 weeks to allow Owner to correct anhy software errors.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment provided under this Section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of equipment manufacturer as approved by ENGINEER.

B. Install equipment as indicated, in accordance with manufacturer's written instruction, and in compliance with recognized industry practices to ensure that products fulfill requirements.

C. Elements that are supported by plumbing or piping, or that have only plumbing or piping connections shall be installed under those Sections.

D. Plumbing, piping, or pneumatic signal connections to elements requiring such connections shall be made under those Sections. Control panels shall be installed in accordance with Division 16 Sections, with piping connections to control panels installed under Division 15 Sections.

E. Drawings are not intended to show every detail of construction or location of piping, ductwork, or equipment. Where proper operation or construction makes it necessary or advisable to change location of piping, instrumentation equipment, air ducts, or other equipment, CONTRACTOR shall so inform ENGINEER for his approval and permission.

3.02 DEMONSTRATION

A. Upon completion of installation and calibration, demonstrate functioning of equipment in accordance with requirements. Where possible, correct malfunctioning units at Site, then retest to demonstrate compliance; otherwise, remove and replace with new or repaired units, and retest to demonstrate compliance.

END OF SECTION

SECTION 13413 - OPTICAL FIBER CABLING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Product and installation requirements for the following:
   1. Fiber-optic (E-FO, C-FO, V-FO, FO) Cables.
   2. Fiber-optic Connectors, Couplers, and Patch Panels.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product data for each type of product specified.
   2. Product certificates, signed by the communication system manufacturers, certifying that the cables are suitable for the connected equipment as described in "Quality Assurance" Article below.

1.03 QUALITY ASSURANCE

A. Manufacturers Qualifications: Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

B. Connected Equipment Manufacturer Certifications: Where cables specified in this Section are used to provide signal paths for systems specified in other sections of these Specifications, or for systems furnished under other contracts, obtain review of the cable characteristics and certification for use with the connected system equipment by the connected equipment manufacturers.

C. UL Compliance: For cables that may be run in plenum ceilings or other air-handling spaces, provide cables tested for compliance with applicable requirements of UL Standard 910, "Test Method for Fire and Smoke Characteristics of Electrical and Optical Fiber Cables Used in Air-Handling Spaces." In addition, provide FO cables that have passed the UL VW-1 flame test.

D. EIA/TIA Compliance: Comply with applicable requirements of EIA Standards, EIA-440, -455, -458, -475, -509, –568-b.3, and 598-a pertaining to optical fiber cable and system component construction and installation. EIA/TIA-455-61, FOTP-61, Measurement of Fiber or Cable Attenuation Using an OTDR.

E. Fiber Optics Experience: CONTRACTOR must be able to prove to the satisfaction of OWNER that it has significant experience in the installation of fiber-optics cable systems. Installation must include installation of fiber-optics cable, fiber termination, knowledge of interconnect equipment, and a thorough knowledge of testing procedures.

F. Labeling: Handwritten labels are not acceptable. All labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or type written onto adhesive labels. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be of a color contrasting with the label such that is may be easily read. If labeling tape is utilized, the font color shall contrast with the background. Patch panels shall exhibit workstation numbers or some type of location identifier, in

sequential order, for all workstations or devices attached. Each fiber-optics cable segment shall be labeled at each end with its respective identifier.

G. Fiber-Optics Interconnect Equipment (Patch Panels): Interconnect equipment shall be used in all fiber cable installations. Patch panels shall be mounted in the equipment racks or panel mounted. Interconnect equipment mounted in racks shall be affixed to the rack by at least 4 screws. All fiber-optics interconnect devices shall be assembled and installed in accordance with the manufacturer's instructions and recommendations.

H. Patch Cords: Patch cords shall be provided for each fiber-optic port on the patch panel. Patch cords shall meet or exceed technical specifications of all installed fiber-optic cable. Patch cord connectors shall be matched with patch panel connector type and network fiber module connector type as required.

1.04 COMMISSIONING

A. Subsequent to hook-ups of FO system to signal sources and destination equipment, operate systems to demonstrate proper functioning. Replace malfunctioning FO cabling system items with new materials, and then retest until satisfactory performance is achieved.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. FO Cables:
      a. Corning Infinicor SX+ Optical Fiber, or Equal, for multi-mode applications.
      b. Corning NexCor Optical Fiber, or Equal, for single-mode applications.
   2. FO Connectors and Couplers:
      a. AMP Netcon.
      b. AT&T Network Systems.
      c. Corning.
      d. Honeywell, Inc.
      e. ITT Corp.
      f. Thomas and Betts Corp.
   3. FO Patch Panels:
      a. Panduit.
      b. Volition.

2.02 OPTICAL FIBER CABLING SYSTEMS

A. Fabricate system using manufacturer's standard materials as indicated by published product information and in sizes, types, and performance characteristics as indicated.

B. FO Cables: Factory fabricated, single channel, all di-electric low loss glass type, fiber-optic multimode graded-index cables with the following operational and construction features:
   1. Multi-mode Fibers:
      a. Cable Type shall be Corning FREEDM One Indoor/Outdoor Tight-Buffered Cable OM4.
      b. Number of Fibers: 6 minimum or as listed on Drawings.

c. Core Diameter: 50 microns or as listed on Drawings.
d. Cladding Diameter: 125 microns or as listed on Drawings.
e. Subunit Size: 2.0 mm or as listed on Drawings.
f. Maximum Attenuation: Less than 2.5 dB/850 nm.
g. Minimum Bandwidth: Greater than 500 MHz-km.
h. Minimum Bend Radius (Unloaded): 10 cm (3.1 in).
i. Operating Temperature Range: -20 to +70 degrees C.

2. Single-mode Fibers:
   a. Cable Type shall be Corning FREEDM One Indoor/Outdoor Tight-Buffered all di-electric Cable.
   b. Number of Fibers: 6 minimum or as listed on Drawings.
   c. Cladding Diameter: 125 microns or as listed on Drawings.
   d. Subunit Size: 2.0 mm or as listed on Drawings.
   e. Maximum Attenuation: Less than 0.5 dB/1,350 nm.
   f. Minimum Bandwidth: Greater than 500 MHz-km.
   g. Minimum Bend Radius (Unloaded): 10 cm (3.1 in).
   h. Operating Temperature range: -20 to +70 degrees C.

C. FO Connectors: Stainless steel, fiber-optic cable connectors, capable of terminating FO glass cables with diameters from 8 through 1,000 microns. Fabricate connectors with optical fiber, self-centering, axial alignment mechanisms. Select ST or SC style connectors as required or shown on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions with the Installer present for compliance with requirements, and other conditions affecting the performance of optical fiber cabling system. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION

A. Install fiber-optic cables and associated equipment and devices in accordance with industry standards and manufacturer's written instructions.

B. Install fiber-optic cable without damage to fibers, cladding, or jacket. Ensure that media manufacturer's recommended pulling tensions are not exceeded. Do not, at any time, bend cables to smaller radii than minimums recommended by manufacturer.

C. Install FO cables simultaneously where more than one cable is being installed in same raceway. Use pulling lubricant where necessary; compound used must not deteriorate cable materials. Do not use soap. Use a pulling means, including fish tape, rope, and basket-weave grips, that will not damage media or raceway.

D. No splices are allowed, except at indicated splice points.

3.03 GROUNDING

A. Provide grounding connections for FO cable and other system components as required by manufacturer's written instructions.

3.04 APPLICATIONS

A. Install optical fiber cabling for project applications as detailed on drawings.

3.05 FIELD QUALITY CONTROL

A. Testing: Testing shall be done by CONTRACTOR with at least 5 years of experience in testing fiber-optic cabling systems. CONTRACTOR shall test each fiber strand. **OWNER reserves the right to have representation present during all or a portion of the testing process. CONTRACTOR must notify OWNER 5 days prior to commencement of testing.** If OWNER elects to be present during testing, test results will only be acceptable when conducted in the presence of OWNER. Any fiber-optic cable left non-terminated at the discretion of OWNER, shall be tested using an adequate light source to determine that all installed strands are not damaged.

B. Fiber-Optics Cable: Each fiber strand shall undergo bi-directional testing for signal attenuation losses using power meter and light source. Testing shall also include Optical Time Domain Reflectometer (OTDR) at both 850 and 1,300 nanometers for all installed fiber strands.
   1. Recommended Test Equipment:
      a. Multimode: Siecor OM-100F and OS-100D or equivalent power meter and light source.
      b. Multimode: Siecor OTDRPlus with appropriate modules for testing.
   2. Tests:
      a. Multi-mode: Bi-directional signal attenuation at 850 and 1,300 nm.
      b. Single-mode: Bi-directional signal attenuation at 850 and 1,300 nm.
   3. Test Criteria: Signal loss of less than 10 dB through entire fiber path, including cable, couplers and jumpers.

C. Documentation (Fiber Optic): CONTRACTOR shall provide documentation to include test results and as-built Drawings. Fiber Test Results: The results of the fiber testing shall be entered into the form "Fiber Attenuation Tests Results." Handwritten results are acceptable provided the test is neat and legible. Copies of test results are not acceptable. Only original signed copies will be acceptable.
   1. Each cable installed shall undergo complete testing in accordance with TIA/EIA TSB-67 to guarantee performance to this standard.
   2. All required documentation shall be submitted within 30 days at conclusion of the project to OWNER.
   3. Test Criteria: Pass rate to conform to latest TIA/EIA Standards that incorporate link performance testing through entire path, including cable, couplers, and jumpers.
   4. Documentation shall conform to Section 13410, 1.02.

D. Acceptance: Acceptance of the Data Communications System, by OWNER, shall be based on the results of testing, functionality, and the receipt of documentation.

3.06 CLEANING

A. Clean optical fiber cabling and components of dirt and construction debris upon completion of installation.

END OF SECTION

SECTION 13421 - FLOW MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Magnetic Flowmeter

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Sections 01330 and 13410, Shop Drawings covering the items included under this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include(no or equal):
   1. Magnetic Flow Meter:
      a. Rosemount.

2.02 MAGNETIC FLOW METER

A. Magnetic flow meters shall be either flanged or flangeless type as indicated. Meters 4 inches or smaller shall be wafer style. Meters 6-inch or larger shall be of flange design.

B. Meter body shall be Schedule 10, 304 stainless steel or Schedule 40 steel with 150-pound ANSI flange or AWWA Class D flange when ANSI is not an available option. Meters 4 inches or smaller shall be wafer or flangeless style and shall be designed for installation between 150 Class and 300 Class ANSI, DIN, or BS pipe flanges.
   1. Wafer or flangeless style meters 4 inches or smaller shall have a ceramic, Teflon, or Tefzel liner and Hastelloy "C" or platinum electrodes as indicated.
   2. Meters 6 to 12 inches shall have Teflon or polyurethane liner and Hastelloy "C" or platinum electrodes as indicated.
   3. Meters 14 inches and larger shall have an Elastomer or polyurethane liner and Hastelloy "C" or platinum electrodes as indicated.

C. Liner material shall be suitable for the process flow indicated on Drawings.
   1. Meters 4 inches or smaller shall be furnished with a Teflon or Tefzel liner. Exception: Ceramic liner shall be furnished for meters 4 inches or smaller used for lime slurry, sludge, and abrasive process flows.
   2. Teflon liner shall be furnished for meters 6 to 12 inches.
   3. Polyurethane liner shall be furnished for meters 14 inches and larger, or if not indicated otherwise on Drawings or in the Specifications.

D. Electrodes shall be suitable for the process flow indicated on the drawings and shall be bullet nosed style made of Hastelloy "C." Exception: Platinum electrodes shall be provided for sodium hydroxide or other caustic process applications.

E. Start-up and acceptance check for flow meters shall be performed by a qualified employee of flow meter manufacturer. Service personnel of sales representative or of equipment supplier of this Section will not be accepted.

F. Meter shall be capable of withstanding continuous submergence in up to 30 feet of water without damage. Field coil design shall be such that they shall not overheat or otherwise be damaged if flow tube is not totally filled with fluid. Magmeters shall be provided with 2 grounding rings. Meter cables shall be factory sealed in meter head by manufacturer. Coordinate exact cable length between meter and transmitter with installation Contractor.

G. Magnetic flow meter signal converter shall consist of solid-state, feedback-type microprocessor circuitry. Operational parameters shall be user configurable locally via an integral push-button arrangement or via a remote intelligent terminal. Appurtenances, including hand-held programmer and/or programming software, shall be provided for local configuration of operational parameters. Converter shall change a low-level flow signal from sensor electrodes into a proportional isolated 4-20 mA DC signal. The converter shall have an extremely high input impedance and not be affected by quadrature noise. The unit shall be capable of accommodating uni-directional or bi-directional flow. Sensing of meter failure shall activate a user-configurable zero or 130 percent output signal and a failure alarm contact closure.

H. Where indicated on Drawings, a high-frequency digital proportional output shall be provided for use with high-accuracy totalizers. To eliminate errors, the converter shall incorporate an integral zero return circuit to provide a constant zero output signal in response to an external dry contact closure. An automatic empty pipe detector and low-flow cutoff shall be provided as standard.

I. Magmeter shall be electronically isolated for grounding. Where insulated or nonconductive pipe is used, only orifice plate-type grounding rings will be acceptable. Grounding electrodes which penetrate the liner will not be acceptable. Ground ring tabs shall be of suitable length to extent above flanges of meter.

J. Unit shall be supplied with an integral or local conduit-mounted flow indicator calibrated in engineering units. Indicator shall be tagged showing design range in units being measured and shall be capable of simultaneously displaying flow rate and totalization with an alphanumeric display.

K. Zero stability shall be achieved by pulsing the sensing head magnetic field coils with a regulated direct current, first in one direction and then in opposite direction.

L. Continuous zero stability shall be obtained by signal sampling during the quiescent coil states. There shall be no zero offset or zero adjustments required. The converter shall not require calibration over its expected life under normal use.

M. Flow meter shall operate within Specifications on 120 volt AC plus 10 percent and 60 hertz plus 5 percent. Power consumption shall not exceed 25 VA for meters 24 inches and smaller, and 50 VA for meters 30 inches or greater.

N. Input span shall be adjustable between 0-1 and 0-30 feet per second and range adjustment shall be digital. Converter shall include adjustable damping circuitry. Unit shall not be affected by power line aberrations such as those produced by SCR-type motor controllers or other voltage transients.

O. System accuracy, including primary magnetic flow meter, shall be plus 0.5 percent of rate for maximum flow velocities from 1.33 to 33.33 feet per second, and plus 1 percent of rate for maximum flow velocities from 0.7 to 1.32 feet per second. Repeatability shall be plus 0.1 percent of span. Rangeability shall meet or exceed 30:1 turndown.

P. The signal converter portion of the magnetic flow meter shall include both a magnetic driver to power the magnetic coils and the signal converter electronics. The converter shall have the ability to be either integrally or remotely mounted as specified. If not specified, converter shall be remotely mounted. It shall be housed in a NEMA 4X case. When remotely mounted, the signal cable shall be provided with the proper length.

Q. Magmeter manufacturer shall comply with ISO9000 Standards and the meter shall be FM approved. Signal converters shall be interchangeable without effect of meter accuracy or the need for recalibration for all meter sizes. Provide spool-piece for meters sized 12 inches and smaller.

PART 3 - EXECUTION

3.01 GENERAL

A. Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.

END OF SECTION

SECTION 13423 - LEVEL MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:
   1. Cord type float switch.
   2. Radar Transmitter

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Sections 01330 and 13410, Shop Drawings covering the items included under this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include(no or equal):
   1. Cord Type Float Switch:
      a. Anchor Scientific, Inc.
      b. Consolidated Electric Co.
      c. Pulsar, Inc.
   2. Radar Transmitter(exact model as shown on drawings):
      a. Vega- Rated class 1, division 1 group c and d with remote indicator rated class 1, division 1 ground c and d.

2.02 FLOAT SWITCH (CORD TYPE)

A. Direct acting float switch shall be furnished to automatically detect liquid level change. Liquid rise of 1 inch from rest position shall operate float switch and reset will occur when liquid level drops 1 inch. Mounting shall be to a 1-inch vertical pipe for multiple float applications or to a flange for a single float application as shown. Free cable hanging floats with weights shall not be acceptable. Vertical pipe and/or flanges for mounting float switches shall be 316 stainless steel.

B. Float switch shall consist of 316 type stainless steel housing, mounting clamp for 1-inch-diameter pipe, flexible 3-conductor cable with a synthetic rubber jacket, and mercury switch. Inside float housing will be a (normally open/closed) mercury switch potted in epoxy. Electrical load for switch contacts shall be rated 115 volt AC at 0.5 horsepower inductive load.

C. Three-conductor cable shall be 14 AWG with 105 strands per conductor made for heavy flexing service and underwater use. A green grounding wire shall connect internally to float housing.

D. Provide mercury free float switches with molded ABS housing and Form C contact switch. CONTRACTOR shall ensure ampere rating is suitable for load shown on Drawing.

PART 3 - EXECUTION

3.01 GENERAL

A. Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.

END OF SECTION

SECTION 13430 - CONTROL PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Control panels and consoles.
   2. Switches, push-buttons, lights.
   3. Relays.
   4. Intrinsically safe isolator relays.
   5. Timing devices.
   6. Terminal blocks.
   7. Control power transformers.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Sections 01330 and 13410, Shop Drawings covering the items included under this Section.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Codes, Ordinances, and Industrial Standards: Design, testing, assembly, and methods of installation for materials, electrical equipment, and accessories proposed under this Section shall conform to National Electric Code and to applicable State and local requirements.
   2. UL listing and labeling of custom-built panels (UL 508) shall be adhered to under this Contract.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Switches, Push-Buttons, Lights:
      a. Preferred: Allen-Bradley (Type 800MR).
      b. American Solenoid Company.
      c. Arrow Hart (Type OB).
      d. Electroswitch. (Type M5, KW or Series 24)
      e. Microswitch (Honeywell) (Series PW).
   2. Relays:
      a. Preferred: Allen-Bradley
      b. Potter-Brumfield (Type KUP).
      c. Schrack North America, Inc. (Type CAD).
      d. Schneider Electric (Square D). (Type KU).
      e. Struthers-Dunn (Type A283).
   3. Latching Relays:
      a. Deltrol (Type 105 ML).
      b. Potter-Brumfield (Type KBP).

c. Struthers-Dunn (Type 255 or 455).

4. Signal Switching Relay:
   a. Airpax.
   b. American Zettler, Inc.
   c. Aromat.
   d. Potter-Brumfield (Type RIOL).
   e. Sigma.
5. Intrinsically Safe Isolator Relay:
   a. B/W Controls, Inc.
   b. MTL, Inc.
   c. R. Stahl, Inc.
   d. Symcom, Inc.
   e. Warrick Controls.
6. Solid-State Timers:
   a. ATC (Series 306D).
   b. Eagle Signal (Type DG100).
7. Solid State Repeat Cycle Timers:
   a. ATC (Series 342).
   b. Eagle Signal (Type DA100).
8. Terminal Blocks
   a. Preferred: Allen-Bradley (Type 1492-P Series).
   b. Altech (Type CTS4U-N).
   c. Schneider Electric (Square D) (Class 9080, Type KCA-1).
   d. Thomas & Betts (100 series or 200 series).
   e. Weidmueller (SAKD2.5N or SAK2.5).
9. Fusible Terminal Blocks:
   a. Preferred: Allen-Bradley (Type 1492-P).
   b. Altech (Type CAFL4U).
   c. Schneider Electric (Square D). (Class 9080, Type KH-1).
   d. Weidmueller (SAKS1 or ASK1).
10. Control Power Transformers:
    a. Acme.
    b. Sola.
11. Textured Polyurethane Enamel:
    a. Sherwin-Williams, Polane T and/or Polane HST.
12. Wire Markers:
    a. Panduit
    b. Brady.
    c. T&B.
    d. Westline.

2.02 CONTROL PANELS

A. Sheet Metal Construction:
   1. Panels shall be fabricated from sheet steel welded and bolted into a rigid self-supporting structure a maximum of 90 inches high and a minimum of 20 inches deep. Overall length shall be coordinated with space requirements as indicated by Drawings. Changes in length from that shown on Drawings must be brought to attention of ENGINEER within 90 days of Contract Award. Cost to modify floor plan or wall opening shall be at CONTRACTOR's expense after this 90-day period. Panel face layouts shown on Drawings are intended to indicate relative

position of all components. Supplier shall fix exact locations and overall dimensions to meet requirements of its equipment.

2. Panel and console bodies shall be 12 gauge minimum steel for panels up to 42 inches in width, and 10 gauge minimum steel for panels exceeding 42 inches in width. Panel subplates shall be same gauge as enclosure. Stiffening members shall be provided for strength and stiffness as required.
3. A minimum of 3 inches shall be provided between edge of panel subplate and outside walls of panel body to ensure adequate wire-way space for external wires entering panel. Panel subplate shall be mounted on collar studs for easy removal. Print pockets shall be provided on each panel. Brackets welded to inside of panel, complete with lights, shall be provided on panels where indicated by Drawings.
4. Identification plates shall be laminated phenolic with white letters engraved on a black background and mounted with screws or double-back adhesive foam tape.
5. All components inside panel shall have identification plates. This includes instruments, relays, switches, circuit boards in plug-in racks, etc. Identification plates shall include engineering symbols (FBQ-1, SW-3, FIC-4, CR-1, etc.). Switches and circuit breakers inside panel shall have names (Horn, Audio Tone, Panel Power, etc.) on identification plates as well as engineering symbol.
6. Identification plates shall be located on or adjacent to device they are identifying and shall be readable without looking around, under, or on top of device to find identification plate.

B. Access:

1. Wall- and/or floor-mounted control panels shall have continuous piano-hinged doors for ease of access. Door openings shall expose a minimum of 80 percent of panel interior. Door openings shall be sealed with a 0.125-inch thick minimum cellular neoprene gasket cemented with oil-resistant adhesive and held in place with a retaining strip. Print pockets shall be provided on each door. Two door enclosures shall have a removable center post. Panel doors less than 40 inches high shall be equipped with a 2-point latching mechanism. Panel doors 40 inches high or more shall be equipped with a 3-point latching mechanism.
2. Components and terminals shall be accessible without removing another component except covers. Swing out sections shall be used if mounting space is required that is not normally accessible.
3. Panels shall have open bottoms except where structural members are required.

C. Finish:

1. Panel face openings for mounting equipment shall be smoothly finished cut with counterboring and trim strips provided as required to give a neat finished appearance. Bezels shall be used on all front panel-mounted devices to cover panel cutouts. A chrome-plated or stainless steel bezel shall be used at parting line of panels that have shipping splits or at parting line of panels placed end to end.
2. Graphic plates, when used, shall be fastened to panel frame with fasteners not visible from front of graphic.
3. After fabrication, panel surfaces shall be given a phosphatizing treatment inside and out, and then finished with 2 coats of textured polyurethane enamel. Panel interior shall be painted white, ANSI No. 51. Exterior color will be selected by ENGINEER.
4. Panels shall have identical exterior finishes as selected by ENGINEER. Panel finishes on matching colored panels shall be identical. It is supplier's responsibility to achieve this result, especially for panels fabricated in different shops.

D. Pneumatics:

1. Interior panel piping shall be grouped, supported, and terminated at bottom of panel at bulkhead fittings unless indicated otherwise. Terminations shall be clearly tagged.
2. Tubing shall be color-coded per ISA RP7.2. Pneumatic systems shall be tested per ISA RP7.1.

E. Electrical:
1. Internal panel wiring shall be a minimum of 19 strand No. 16 AWG, 90^{O}C MTW, Class C stranded, or THHN/THWN approved as 90^{O}C MTW. All panel wiring not run in wire ducts shall be bundled and tied. Each wire shall be identified at both ends with same exclusive number. Number shall be same number shown on control schematic. Number shall not be used again for any other purpose. Wires marked differently on each end will not be accepted. Wire markers shall be provided on end of each wire at termination point.
2. Control wiring associated with control circuits de-energized when main disconnect is opened shall be color-coded yellow. Control wiring associated with control circuits which remains "hot" when main disconnect is opened shall be color-coded orange. Wiring to descrete I/O points shall be color-coded yellow. Control wiring associated from a source outside of the panel shall be color-coded orange. 120VAC control circuits shall be color-coded red for hot and white for neutral. DC control wiring shall be color-coded blue for positive and gray for negative. Ground wires shall be color-coded green. Terminal blocks shall be numbered in numerical order. Orange wiring leaving panel shall be brought to an isolated set of terminal blocks. Wires leaving the panel shall be brought to a separate set of terminals along the edge of the backpanel.
3. Provide an instrument common bus 0.1 by 0.5 by 6-inch minimum in enclosure and isolated from enclosure. A separate instrument common wire shall be run from each common terminal on an instrument to instrument common bus. Instrument common wires looped from one terminal to another and then to instrument common bus will not be accepted.
4. Instrument common bus shall be connected to power supply common with a wire or wire braid strap as short as practical and of sufficient capacity to prevent troublesome voltage drop. Common terminals and common bus for instrument common shall be tagged "Instrument Common." Instrument signal wires of 4-20 mA or 1-5V shall be shielded wire. Telephone wires and telemetry equipment interconnection wires shall be shielded wires.
5. Provide a copper ground bus 0.1 by 0.5 by 6-inch minimum in enclosure to which all instrument grounds and panel enclosure are tied. Separate ground wire shall be run from instrument enclosure ground terminal directly to ground bus. Instrument ground wires looped from one instrument to another will not be accepted. Under no circumstances shall neutral side of power source or any other terminals used for grounding power circuits be used as an instrument common.
6. Wires to internal components shall be connected to inside of terminal strip. Wires to external components shall be connected to outside of terminal strip. No more than 2 wires shall be connected to one terminal point.
7. Panel wire duct shall be provided between each row of components and adjacent to each terminal strip. Wire ducts shall be a minimum of 1-inch wide and 3 inches deep with removable snap-on covers and perforated walls for easy wire entrance. Wire ducts shall be constructed of nonmetallic materials with a voltage insulation in excess of maximum voltage carried therein.
8. Floor-standing panels and consoles shall be equipped with a flange mounted 600V rated main non-automatic trip circuit breaker or disconnect switch. Single phase, 60 hertz power at voltage shown on Drawings shall be supplied to main disconnect. Panel fabricator shall provide any additional voltages and power requirements at control panel to meet requirements of equipment contained therein.
9. Disconnect and transformer shall have enclosed protected terminations to prevent accidental shock.
10. Relays, timers, etc., installed on panel subplate shall be provided with a minimum spacing between component and wire duct of 1.5 inches above and 1 inch below. Minimum spacing

between adjacent components shall be 0.25 inch. Relays, timers, etc., shown in schematics are intended to show function. Additional relays may be required in conjunction with items shown to provide total number of contacts required. Where limit, pressure, float switches, etc., are used and more than SPDT contacts are indicated by schematics, provide additional contacts required by using auxiliary relays. However, if a DPDT switch is called for, using a SPDT with a relay will not be accepted. All control and pilot devices such as relays, timers, etc., shall be 120V, 3 amp rated except where noted with coil voltage as required. One N.O. spare contact shall be provided on each relay.

F. Panel/Subplate Layout:
   1. Panel face-mounted equipment shall consist of pilot lights, push-buttons, selector switches, meters, indicating timer, etc. Spacing between horizontal rows of components shall be 1.5 inches minimum; spacing between vertical columns of components shall be 1.875 inches minimum. Components shall be grouped and/or located as indicated on Drawings. Distance from bottom row of components to floor shall be not less than 36 inches. Top row of recording and indicating instruments shall be centered approximately 60 inches above floor. Maximum height for annunciator windows shall be 85 inches above floor. In general, indicating lights, push-buttons, etc., shall be mounted in accordance with sequence of operation from left to right and top to bottom.
   2. A minimum of 2 inches shall be provided between terminal strips and wire ducts or terminal strips and terminal strips. In general, terminal strips shall be mounted on vertical edges of subplate. Where terminal strips are mounted side-by-side, terminals shall be elevated 1.5 inches above subplate to allow wires to pass underneath.
   3. Subplates shall have a minimum of 15 percent spare mounting space, and terminal strips shall have a minimum of 20 percent spare terminal blocks.

2.03 SWITCH, PUSH BUTTONS, LIGHTS

A. Selector switches shall be 120 VAC rated, oil-tight construction with standard operator knob.

B. Start push buttons shall be 120 VAC rated, oil-tight construction with extended guard and black color insert.

C. Stop push-buttons shall have a half-guard with red color insert. Contacts shall be rated NEMA B-150 and P-150.

D. Pilot lights shall be push-to-test oil-tight construction with cap colors and voltages as required. Pilot light shall be supplied with Light Emitting Diode (LED) type light module.

E. Stopped condition shall be color red. Running condition shall be color green.

F. Nameplates for each switch and light shall conform to manufacturer's series and type with engraving as called for on Drawings.

2.04 RELAYS

A. Control Relays: Switching and output relays shall be plug-in type with contacts rated 120 VAC, 3 amp with 120 VAC or 24 VDC coil, indicating light, manual operator, and plastic transparent cover. Relays shall have a retainer mechanism to prevent loosening from vibration. Relays shall not be used for switching 1-5 VDC or 4-20 mA signals associated with instruments.

B. Latching Relays: Latching relays shall be transparent enclosed plug-in type with mechanical or magnetic latching, mechanical holding device, contacts rated 120V at 3 amps, and continuous duty coils. These relays shall not be used for switching 1-5 VDC or 4-20 mA signals associated with instruments.

C. Signal Switching Relays: Instrument relays shall be those relays switching a 1-5 VDC or 4-20 mA signal. Instrument relays shall be transparent enclosed plug-in type with indicating LED and mechanical holding mechanism. Relay contacts shall be dry circuit type rated 250 mA maximum. Contact material shall be a gold-platinum-silver alloy.

2.05 TIMING DEVICES

A. Solid-state timers shall be plug-in type.

B. Solid-state timers with ON or OFF delay cycles shall operate at 120 VAC, 60 hertz. Solid-state device may be analog or digital in operation. Time interval shall be as shown on Drawings or as required.

C. Solid-state repeat cycle timers with adjustable ON-OFF cycles shall operate at 120 VAC, 60 hertz. Solid-state device may be analog or digital in operation. Time interval shall be as shown on Drawings or as required.

2.06 TERMINAL BLOCKS

A. Terminal blocks shall be 300 or 600 volt rated, channel-mounted box lug with pressure plate type or binding head screw type with pressure plate, and shall have a white marking strip. Terminal blocks shall be color-coded according to the following coloring scheme:

Black 120V power circuits de-energized when main disconnect is opened.
White 120V neutral conductors.
Yellow 120V control circuits de-energized when main disconnect is opened, and discrete I/O wiring
Orange 120V control circuits which remain hot when main disconnect is opened, and control circuits orginating outside the panel.
Blue Terminal blocks for + DC wiring.
Gray Terminal blocks for - DC wiring.
Green Ground terminal blocks.

B. For terminals associated with 120V nonisolated input cards, individually fused terminal blocks shall be used for 120V power to field devices.

C. Provide a minimum of 20 percent spare terminals for each type and color of terminal used. All terminals of a given color shall be grouped with other terminals of the same color.

D. Terminals shall be sized for the loads carried.

E. Multi-tiered terminals blocks to include shield wiring, and preferred for analog signals.

F. 480VAC terminal blocks shall be colored to match phase wire.

2.07 CONTROL POWER TRANSFORMERS

A. Control power transformers shall be sized to handle in-rush currents and to accommodate continuous load of circuits plus 25 percent future load with 5 percent or less voltage drop. Transformer primary voltage shall be as indicated on Drawings.

PART 3 - EXECUTION

3.01 GENERAL

A. Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.

END OF SECTION

SECTION 141200
ELECTRIC DUMBWAITERS

PART 1 GENERAL

PART 2 PRODUCTS

2.01 DESCRIPTION

A. Type ED- ___ , Electric Dumbwaiters:

2.02 CONTROLS

A. Provide automatic operation with full bank of operating buttons at each landing numbered to correspond to landings served.

1. Call or dispatch car to various landings by momentary pressure of respective buttons when landing doors are closed.

2. Indicate arrival of car at landings by light and audible bell at landing.

3. Deactivate buttons while car is in motion, and for short period of time upon arrival at landing to allow time to open door.

4. Provide two additional buttons marked IU (Inching Up) and ID (Inching Down) at each entrance, to level car to align with landing by applying constant pressure on button while both car door and hoistway door are open, and that car is within this inching zone.

END OF SECTION 141200

SECTION 16050 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: General administrative, procedural requirements, and installation methods for electrical installations specified in Division 16.

B. The Drawings are schematic and are not intended to show every detail of construction.
   1. In general, conduits/raceways, transitions and offsets shown on Drawings indicate approximate locations in plan and elevation where the systems are intended to be run.
   2. CONTRACTOR shall fully coordinate electrical Work with other trades to avoid interferences.
   3. In the event of interferences, CONTRACTOR shall request clarification from ENGINEER in writing.

B. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Sections, apply to Work of this Section.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with requirements of Section 01330, Shop Drawings covering the items included under this Section of Work. Shop Drawing submittals shall include:
   1. Submit product data covering the items included under this Section of Work.

B. Conforming to Construction Drawings: Submit a complete set of Drawings showing the locations of the piping, ductwork, etc., as actually installed, and addendums. Such Drawings shall be submitted to ENGINEER on tracing cloth, Mylar, or sepia paper from which blueprints can be obtained. Such Drawings shall also be provided on a thumb drive in AutoCAD format.

C. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01600, operation and maintenance manuals for items included under this Section. Include following information for equipment items:
   1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
   2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
   3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
   4. Servicing instructions and lubrication charts and schedules.
   5. Submit 2 hard copies and 1 electronic copy on a thumb drive in Adobe Acrobat and Microsoft Word formats of all Maintenance and Operation Manuals and procedures.

1.03 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with requirements in Section 01770. In addition, CONTRACTOR shall submit, prior to final payment, Drawings conforming to construction records of systems it has installed. Vendor drawings shall be sized as manufacturers' standard.

B. Provide typewritten data sheets on motor control circuits with following information on each branch feeder: Load name, horsepower or KVA (transformer), fuse size, starter size, service factor of motor, motor nameplate currents, power factor correction capacitor size (if used), and thermal overload part number.

1.04 QUALITY ASSURANCE

A. National Electrical Code: Comply with NFPA 70, National Electrical Code.

B. UL Compliance and Labeling: Use products and components labeled by UL.

1.05 PERMITS, INSPECTIONS, AND LICENSES

A. CONTRACTOR shall procure all necessary permits and licenses, observe and abide by all applicable laws, codes, regulations, ordinances, and rules of the State, territory, or political subdivision thereof, wherein Work is done, or any other duly constituted public authority, and further agrees to hold OWNER harmless from liability or penalty which might be imposed by reason of an asserted violation of such laws, codes, regulations, ordinances, or other rules.
   1. Upon completion of Work, CONTRACTOR shall secure certificates of inspection from the inspector having jurisdiction and shall submit 3 copies of the certificates to OWNER. CONTRACTOR shall pay the fees for the permits, inspections, licenses, and certifications when such fees are required.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification. Equipment shall be packaged to prevent damage during shipment, storage, and handling. Do not install damaged units; replace, and remove damaged units from Site.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 GENERAL ELECTRICAL INSTALLATION

A. Provide electrical materials and equipment enclosures appropriate for areas in which they are installed. Each area will be designated on Drawings with a type of construction such as NEMA 4, 4X, 7 or 9 if it is other than NEMA 12. An area designated by a name and elevation includes space bounded by floor, ceiling, and enclosing walls.
   1. Exception: Provide manufacturer's standard construction for indoor or outdoor application where equipment is not manufactured to NEMA specifications (e.g., switchgear, transformers, high voltage capacitors, bus duct, and light fixtures; materials and equipment used in finished areas such as offices, laboratories, etc.).

B. Provide stainless steel or PVC-coated metallic electrical materials and equipment enclosures in NEMA 4X areas; watertight NEMA 4 and equipment enclosures for outdoor applications and indoor applications below grade; explosion-proof NEC Class I, Division 1, Group C and Group D equipment for NEMA 7 areas; explosion-proof NEC Class II, Division 2, Group F equipment for NEMA 9 areas.

C. Coordinate with power company high voltage and/or low voltage metering requirements. Furnish, install, and connect metering equipment not furnished, installed or connected by power company.

D. Provide chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.

E. Supporting devices and sleeves shall be set in poured-in-place concrete and other structural components as they are constructed.

F. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom possible. Locate light fixtures at approximately 8 feet above floor and where fixtures may be readily serviced.

G. 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.

H. Install systems, materials, and equipment to conform with approved submittal data, including coordination Drawings, to greatest extent possible. Conform to arrangements indicated by Drawings recognizing that portions of Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to ENGINEER.

I. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components where installed exposed in finished spaces.

J. As much as practical, connect equipment for ease of disconnecting with minimum of interference with other installations.

K. Install access panel or doors where units are concealed behind finished surfaces.

L. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.02 RACEWAY INSTALLATION

A. Outdoors, use the following materials:
   1. Exposed Conduit: PVC externally coated rigid metal conduit and fittings.
   2. Underground Direct Buried Conduit: PVC externally coated rigid metal conduit.
   3. Underground Concrete Encased Conduit: Fiberglass-reinforced conduit or rigid nonmetallic conduit if the conductors are used for power or 120 VAC; otherwise, use rigid metal conduit.
   4. Conduit Used to Connect to Vibrating Equipment including transformers and hydraulic, pneumatic or electric solenoid or motor-driven equipment: Liquidtight flexible metal conduit.

B. Indoors, use the following wiring materials:

1. Connection to Vibrating Equipment, including transformers and hydraulic, pneumatic or electric solenoid or motor-operated equipment: Liquidtight flexible metal conduit.
    a. Exception: NEMA 7 or 9 areas require explosion-proof flexible conduit.
2. Exposed Conduit(Nema 12 and Nema 4 areas): PVC externally coated rigid metal conduit or aluminum conduit.
    a. Exceptions:
        1) Areas indicated as NEMA 4X, use rigid Schedule 80 PVC conduit.
        2) Areas indicated as NEMA 7 or NEMA 9 (such as grit and raw sewage rooms), use PVC externally coated rigid metal conduit.
3. Concealed Conduit: Rigid metal conduit or aluminum conduit unless indicated otherwise.

C. Minimum size conduit shall be 1 inch unless shown otherwise.

D. Instrument Signal Conduit Requirements: Shielded signal wires for 4-20 mA type instruments or thermocouple wires assigned to the same control panel may be run in the same conduit. Shielded instrument signal wires, thermocouple wires, and shielded 2-wire intercom wires may be run in the same conduit. No other wires will be permitted in an instrument signal/2-wire intercom conduit. Conduit shall be Rigid Aluminum or PVC-coated RMC.

E. Conduit Thread Paint: Make threaded conduit joints watertight by coating threaded portions with a spray-on or brush-on zinc-bearing paint. Provide paint containing 90 percent minimum by weight of metallic zinc powder in the dried film. Clean field-cut threads of oil using the recommended solvent prior to coating threads.

F. Install expansion fittings in all exposed rigid nonmetallic conduit runs of 20 feet or more.

G. Install expansion/deflection fittings where conduit passes a building expansion joint or where conduits are attached to two structures joined by a concrete expansion joint.

H. Exposed Construction: Install conduit exposed inside buildings except for areas with finished walls (e.g., offices, laboratories, lavatories, locker rooms, etc.) unless otherwise indicated.

I. Concealed Raceways: No conduits shall be installed in any concrete pours, floors, or walls.

J. Exposed Raceways: Install parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. Make bends and offsets so the inside diameter is not effectively reduced. Keep the legs of a bend in the same plane and the straight legs of offsets parallel. Conduits shall slope away from loads to keep moisture from entering the load. Run parallel or banked raceways together. Make bends in parallel or banked runs from the same centerline so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run, such as from wall to ceiling and that the raceways be of the same size. In other cases, provide field bends for parallel raceways. 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.

K. Space raceways, fittings, and boxes 0.25 inch from mounting surface in NEMA 4 and NEMA 7 areas. Spacers shall be one-piece construction of stainless steel, galvanized steel, PVC, ABS, or other noncorrosive material.

L. Sleeves: Install in concrete floor slabs except where conduit passes through a housekeeping pad. Install in exterior walls below grade.

M. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid metal conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs with floor.

N. Flexible Connections: Use short length (maximum 6 feet for lighting fixtures; maximum 3 feet for all other equipment) of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement, and all motors. Use liquidtight flexible conduit in wet locations and rated flexible connections for hazardous locations. Install separate ground conductor across flexible connections.

O. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.

P. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate metal conduit, use threaded rigid metal conduit fittings. For PVC externally coated rigid metal conduit, use only factory-coated fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit.

Q. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL listed sealing compound. For concealed raceways, install each fitting in a flush metal box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
   1. Where conduits enter or leave hazardous locations.
   2. Where conduits enter or leave NEMA 4X areas.
   3. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
   4. Where required by the NEC.
   5. Where noted on drawings.

R. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring. Provide knockout closures to cap unused knockout holes where blanks have been removed.

S. Install device boxes at the height above the floor as follows for:
   1. Light switches, 4 feet.
   2. Receptacles and telephone jacks, 18 inches except in NEMA 4 and 4X areas, 4 feet.
   3. Thermostats, 4'-0".
   4. Clock receptacles, 7'-0".

T. Avoid installing boxes back-to-back in walls. Provide not less than 6-inch (150 mm) separation.

U. Position recessed outlet boxes accurately to allow for surface finish thickness.

V. Fasten electrical boxes firmly and rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete masonry.

W. Provide fire-retardant barriers in all pull and junction boxes containing circuits that are otherwise continuously separated in conduit. Securely fasten these barriers within box. Size barriers so that space between barrier and box wall does not exceed 0.125 inch anywhere around the perimeter of barrier.

X. Support exposed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.

Y. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from building structure.

Z. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box and tighten the chase nipples so no threads are exposed.

AA. Complete installation of electrical raceways before starting installation of conductors within raceways and prevent foreign matter from entering raceways by using temporary closure protection. Cap spare conduit. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

BB. Install pull wires in empty raceways: Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-pound tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

3.03 WIRE AND CABLE INSTALLATION

A. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant where necessary.

B. Keep branch circuit conductor splices to minimum. Splice feeders only where indicated. Use a standard kit. No splices are allowed for instrument and telephone cables except at indicated splice points.

C. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced. Use splice and tap connectors which are compatible with conductor material and are UL listed as pressure type connectors.

D. Provide adequate length of conductors within electrical enclosures and train conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at terminal.

E. Terminate power conductors at equipment using pressure-type terminals specifically designed for type of terminations to be made. Terminate no more than 2 conductors No. 8 AWG and smaller within the same pressure-type terminal. These 2 conductors shall be no more than 4 wire gauge sizes apart. Terminate no more than 1 conductor larger than No. 8 AWG within any pressure-type terminal.

1. Exception: Power factor correction capacitor conductors may be terminated at the motor disconnect switch load terminals.

F. Seal wire and cable ends until ready to splice or terminate.

3.04 CUTTING AND PATCHING

A. Perform cutting and patching in accordance with requirements in Section 01730. In addition, the following requirements apply.
   1. Perform cutting, fitting, and patching of electrical equipment and materials required to uncover Work to provide for installation of ill-timed Work, remove and replace Work that is either defective or does not conform to requirements of Drawings.
   2. Cut, remove, 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 new Work. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.
   3. Patch existing finished surfaces and building components using new materials matching existing materials.

3.05 EQUIPMENT CHECKOUT AND TESTING

A. In addition to testing recommended by equipment or material supplier and called for in equipment or material specification, perform the following.

B. Motor Testing: Motor insulation shall be tested by using a 500 VDC (minimum) megger and applying test until a constant megohm reading of the following magnitude is obtained:

$R_{min.}$ = 4 (KV + 1) at 25 degrees C winding temp.
$R_{min.}$ = IV + 1 at 40 degrees C winding temp.

   1. If motors do not meet requirements of megger test, blow hot air through motors to dry out and repeat until test is passed. If desirable, drying can be done by applying an electrical potential to equipment. However, in no case, induced or direct, shall voltage or current exceed continuous rating of equipment being dried.
   2. After passing megger test, motors shall be hi-pot tested at 200 percent rated voltage for a minimum of 1 minute.

C. Equipment Testing: The following tests which are applicable for a particular item of equipment shall be performed:
   1. Megger bus work phase-to-phase and phase-to-ground. Minimum acceptable steady-state value is 100 megohms.
   2. Megger power circuit breakers and circuits supplied phase-to-phase and phase-to-ground (100 megohms minimum).
   3. Test current transformer circuits by applying current to secondary wiring at current transformer terminals until contactor trips.
   4. Test, time, and set protective relays. Relays shall be timed at various multiples (minimum of 3 points) of the pick-up value to determine agreement with published curves and adjust as necessary to agree with coordination study required settings. Exact tests to be performed vary with type of relay. Manufacturer's instructions for relay shall be complied with.

5. After Work has been completed, demonstrate to OWNER's Representative that entire electrical installation is in proper working order and will perform functions for which it was designed by functional testing.
6. Make any specific tests required by the manufacturer's installation instructions.

D. Check-out Procedures. In general, check-out procedures (as listed below) which are applicable for a particular item of equipment shall be performed:
   1. Vacuum interior of cubicles and remove foreign material.
   2. Wipe clean with a lint-free cloth insulators, bushings, bus supports, etc.
   3. Check and adjust time delay, under-voltage devices, phase relay, over-current relays, etc., as required by coordination study or ENGINEER.
   4. Fill motor bearings requiring oil.
   5. Check and change, as required, thermal overload heater elements to correspond with motor full-load current and service factors of installed motor.
   6. Check direction of rotation of motors and reverse connections if necessary. Check rotation with motor mechanically uncoupled where reverse rotation could damage equipment.
   7. Equipment with two or more sources of power connected by tie breakers, transfer switches, or generator receptacles shall be checked for rotation from each possible combination of power sources. Power sources must have the same phase sequence for each source throughout entire facility.
   8. Check exposed bolted power connections for tightness.
   9. Check operation of breakers, contactors, etc., and control and safety interlocks.
   10. Check tightness of bolted structural connections.
   11. Check leveling and alignment of enclosures.
   12. Check operating parts and linkages for lubrication, freedom from binding, vibration, etc.
   13. Check tightness and correctness of control connections at terminal blocks, relays, meters, switches, etc.
   14. Clean auxiliary contacts and exposed relay contacts after vacuuming.

END OF SECTION

SECTION 16052 - COORDINATION STUDY AND ARC FLASH ANALYSIS

PART 1 - GENERAL

1.01 SUBMITTALS

A. Coordination Study detailing electrical system protection, protective equipment selectivity and arc flash hazard analysis studies shall be performed for this project.

B. Submit electronic copies of the SKM raw data software files(the files created by the SKM software). The reports shall include the following sections:
   a. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations
   b. Descriptions, purpose, basis and scope of the study
   c. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings
   d. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings
   e. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout
   f. Incident energy and flash protection boundary calculations
   g. Comments and recommendations for system improvements, where needed
   h. Executive Summary including source of information and assumptions made

1.02 COORDINATION STUDY

A. Include as part of Contract a complete Coordination and Short Circuit Study from incoming power lines primary switches and transformers through the high voltage switchgear, unit substations, and the motor control centers branch circuits for the new work shown this contract. This includes new medium voltage equipment and circuit breakers installed within existing motor control centers. Obtain available short circuit current, inrush current, and upstream protective device time current curves from the power company. Include power company current data and protective device curve as part of study. Study shall include all coordinating curves with each fuse size, trip settings, and thermal overloads given for connected loads. Curves shall include feeder wire melting curves and transformer ANSI rating points. The study shall also include variable frequency drives harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear. Fuse sizes on motor control centers shall be those shown in Drawings throughout the short circuit and coordination study. Changes in loads from those shown on Drawings shall be incorporated in Study.

B. Analysis and labeling shall include the existing motor control centers as well as the new motor control centers and medium voltage equipment shown on the contract drawings.

C. Contractor shall furnish all field data as required for the power system studies and arc flash hazard analysis studies. Include fault contribution of existing motors in the study, with motors < 50 hp

grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

D. Study/report shall be performed by Eaton, Square D, or Rockwell. Study results shall be submitted to ENGINEER for approval. Report shall be stamped by a licensed professional electrical engineer in the state of Michigan. Final report shall include the SKM raw data files to be turned over to Owner.

E. After approval all electrical equipment settings, thermal overloads, and fuses shall be made to conform to approved results. CONTRACTOR shall test all trip settings, time delays, and indicating devices on all switchgear, unit substations, and motor control centers. Tests shall be witnessed by ENGINEER.

F. Data sheets for test are to be furnished by CONTRACTOR and shall be filled out showing the desired settings from Coordination Study and results obtained from witnessed test. Data sheets shall be signed by those performing test and witness. Test data sheets and motor list showing fuses, thermal overload sizes, etc. shall be submitted to ENGINEER as part of Contract.

G. Turn over SKM data files to Owner at project completion.

H. Report shall be stamped by a licensed professional engineer in the state of Michgain.

I. Eaton, Square D, or Rockwell shall install new labels for the entire lift station.

J. Eaton, Sqaure D, or Rockwell shall collect all the data necessary to produce the studies specified herin.

PART 2 - PRODUCTS

2.01 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition. Transformer design impedances and standard X/R ratios shall be used when test values are not available.

B. Provide the following information in the study report:
   1. Calculation methods and assumptions.
   2. Base per unit quantities.
   3. One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted.
   4. Source impedance data, including electric utility system and motor fault contribution characteristics.
   5. Typical calculations and tabulations of calculated quantities.
   6. Results, conclusions, and recommendations.

C. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
   1. Electric utility’s supply termination point.
   2. Incoming switchgear.
   3. Unit substation primary and secondary terminals.

4. Low voltage switchgear.
5. Motor control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.
8. Other significant locations throughout the system.

D. On grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

E. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings.
2. Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses.
3. Adequacy of transformer windings to withstand short-circuit stresses.
4. Cable and busway sizes for ability to withstand short-circuit heating.
5. Notify Owner in writing, of existing circuit protective devices improperly rated for the calculated available fault current.

2.02 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.

B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the curve sheets, where applicable:
1. Electric utility's protective device
2. Medium voltage equipment relays
3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
5. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters
6. Conductor damage curves
7. Ground fault protective devices, as applicable
8. Pertinent motor starting characteristics and motor damage points
9. Pertinent generator short-circuit decrement curve and generator damage point
10. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.03 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

D. The Arc-Flash Hazard Analysis shall include all medium voltage and 480v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 15 kVA.

E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

2.04 REPORT SECTIONS

A. Input Data:
1. Utility three-phase and line-to-ground available contribution with associated X/R ratios
2. Short-circuit reactance of rotating machines with associated X/R ratios
3. Cable type, construction, size, # per phase, length, impedance and conduit type
4. Bus duct type, size, length, and impedance
5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio
6. Reactor inductance and continuous ampere rating
7. Aerial line type, construction, conductor spacing, size, # per phase, and length

B. Short-Circuit Data:
1. Source fault impedance and generator contributions
2. X to R ratios
3. Asymmetry factors
4. Motor contributions
5. Short circuit kVA
6. Symmetrical and asymmetrical fault currents

C. Recommended Protective Device Settings:
   1. Phase and Ground Relays:
      a. Current transformer ratio.
      b. Current setting.
      c. Time setting.
      d. Instantaneous setting.
      e. Specialty non-overcurrent device settings.
      f. Recommendations on improved relaying systems, if applicable.
   2. Circuit Breakers:
      a. Adjustable pickups and time delays (long time, short time, ground).
      b. Adjustable time-current characteristic.
      c. Adjustable instantaneous pickup.
      d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations.
   1. Arcing fault magnitude
   2. Device clearing time
   3. Duration of arc
   4. Arc flash boundary
   5. Working distance
   6. Incident energy
   7. Hazard Risk Category
   8. Recommendations for arc flash energy reduction

PART 3 – EXECUTION

3.01 ARC FLASH WARNING LABELS

A. The CONTRACTOR shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The label shall have an orange header with the wording, “WARNING, ARC FLASH HAZARD”, and shall include the following information:
   1. Location designation
   2. Nominal voltage
   3. Flash protection boundary
   4. Hazard risk category
   5. Incident energy
   6. Working distance
   7. Engineering report number, revision number and issue date

C. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
   1. For each 600, 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided.
   2. For each motor control center, two arc flash labels shall be provided, one at each end of the motor control center.
   3. For each low voltage switchboard, one arc flash label shall be provided

4. For each switchgear or unit substations, two arc flash labels shall be provided, one at each end of the equipment or near each main breaker.
5. For each medium voltage switch, one arc flash label shall be provided.

D. Labels shall be field installed by the electrical supplier performing the studies, local power company, or engineering service division of the equipment manufacturer during the Startup and Acceptance Testing.

3.02 ARC FLASH TRAINING

A. Eaton, Square D, or Rockwell shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 8 hours, one trip to the Owners facility). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET). Assume for twenty (20) individuals of the Owners staff to be trained.

END OF SECTION

SECTION 16060 - GROUNDING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Electrical grounding and bonding Work as follows:
   1. Solidly grounded.

B. Applications of electrical grounding and bonding Work in this Section:
   1. Underground metal piping.
   2. Underground metal water piping.
   3. Underground metal structures.
   4. Metal building frames.
   5. Electrical power systems.
   6. Grounding electrodes.
   7. Separately derived systems.
   8. Raceways.
   9. Service equipment.
   10. Enclosures.
   11. Equipment.
   12. Lighting standards.
   13. Landscape lighting.
   14. Signs.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product Data: Submit manufacturer's data on grounding and bonding products and associated accessories.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. UL Compliance: Comply with applicable requirements of UL Standards No. 467, "Electrical Grounding and Bonding Equipment," and No. 869, "Electrical Service Equipment," pertaining to grounding and bonding of systems, circuits, and equipment. In addition, comply with UL Standard 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL listed and labeled for their intended usage.
   2. 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.

PART 2 - PRODUCTS

2.01 GROUNDING AND BONDING

A. Materials and Components:
   1. Except as otherwise indicated, provide electrical grounding and bonding systems indicated; with assembly of materials including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for 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 which comply with NEC, UL, and IEEE requirements and with established industry standards for those applications indicated.
   2. Conductors: Electrical copper grounding conductors for grounding system connections that match power supply wiring materials and are sized according to NEC.
   3. Ground Bus: 0.25 inch by 1 inch minimum copper ground bus where indicated.
   4. Service Arrester: Electrical service arrester, 480 volts, 3-phase, 4-wire, for exterior mounting.
   5. Grounding Electrodes: Steel with copper welded exterior, 3/4-inch diameter by 20 feet.
   6. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS

A. Connect grounding conductors to underground grounding electrodes using exothermic weld process or mechanical compression type connectors.

B. Ground electrical service system neutral at service entrance equipment to grounding electrodes.

C. Ground each separately derived system neutral to effectively grounded metallic water pipe, effectively grounded structural steel member, and separate grounding electrode.

D. 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.

E. Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug, bus, or bushing.

F. Connect grounding electrode conductors to 1-inch diameter or greater, metallic cold water pipe using a suitably sized ground clamp. Provide connections to flanged piping at street side of flange.

G. Connect building reinforcing steel, building steel beam, building steel roof and walls and duct bank and vault reinforcing steel to ground mat using No. 4/0 AWG bare copper grounding cable.

H. Bond bare No. 4/0 AWG grounding cable in duct banks to grounding cable in vaults and to power equipment ground bus at ends of each duct bank.

I. Bond strut and other metal inside of electrical manholes and vaults to bare No. 4/0 AWG grounding cable carried in duct bank.

J. Bond grounding cables to both ends of metal conduit or sleeves through which such cables pass.

K. 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.

L. Install braided type bonding jumpers with code-sized ground clamps on water meter piping to electrically bypass water meters.

M. Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible while following building lines to minimize transient voltage rises. Protect exposed cables and straps where subject to mechanical damage.

N. Apply corrosion-resistant finish to field connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed and are subjected to corrosive action.

3.02 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester using the 3-point fall of potential method. Testing shall be performed during normal dry weather conditions with at least 5 non-rain days elapsing prior to test. Where tests show resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms or less by driving additional ground rods; then retest to demonstrate compliance.

B. Test ground paths for continuity by applying a low DC voltage source of current, capable of furnishing up to 100 amps, between electrical equipment grounds and ground grid. Grounding path must conduct a 100-amp current at a resistance of 0.010 ohms or less as calculated from circuit voltage.

C. Test results shall be provided to the City in the Drawings.

END OF SECTION

SECTION 16070 - SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product data for each type of product specified.

1.03 QUALITY ASSURANCE

A. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Slotted Metal Angle and U-Channel Systems:
      a. Allied Tube & Conduit.
      b. American Electric.
      c. B -Line Systems, Inc.
      d. Cinch Clamp Co., Inc.
      e. GS Metals Corp.
      f. Haydon Corp.
      g. Kin-Line, Inc.
      h. Unistrut Diversified Products.
   2. Conduit Sealing Bushings:
      a. Bridgeport Fittings, Inc.
      b. Cooper Industries, Inc.
      c. Elliott Electric Mfg. Corp.
      d. GS Metals Corp.
      e. Killark Electric Mfg. Co.
      f. Madison Equipment Co.
      g. L.E. Mason Co.
      h. O-Z/Gedney.
      i. Producto Electric Corp.
      j. Raco, Inc.
      k. Red Seal Electric Corp.
      l. Spring City Electrical Mfg. Co.
      m. Thomas & Betts Corp.

2.02 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be stainless steel. Products for use outdoors, in NEMA 4 areas, or embedded in concrete or in Nema 12 areas indoors shall be stainless steel.

2.03 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and stainless steel spring clamps.
B. Fasteners. Types, materials, and construction features as follows:
   1. Expansion Anchors: 316 stainless steel wedge or sleeve type.
   2. Toggle Bolts: 316 stainless steel springhead type.
   3. Hanger Rods: 0.375-inch diameter minimum, 316 stainless steel.
C. Conduit Sealing Bushings: Factory fabricated, watertight conduit sealing bushing assemblies suitable for sealing around conduit or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
D. Cable Supports for Vertical Conduit: Factory fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of 304 stainless steel.
E. U-Channel Systems: 12 gauge or 0.105-inch-thick 316 stainless steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center in top surface. Provide fittings and accessories that mate and match with U-channel and are of same manufacturer.

2.04 FABRICATED SUPPORTING DEVICES

A. Shop- or field-fabricated supports or manufactured supports assembled from U-channel 316 stainless steel components.

B. 316 stainless steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide a waterstop on pipe sleeves. Provide pipe sleeves of 2 standard sizes larger than conduit/pipe passing through it and of one of the following:
   1. Steel Pipe: Fabricate from Schedule 40 stainless steel pipe.
   2. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including, but not limited to, the following:
   1. Buried electrical line warnings.
   2. Identification labeling for cables and conductors.
   3. Operational instruction signs.
   4. Warning and caution signs.
   5. Equipment labels and signs.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product Data for each type of product specified.

PART 2 - PRODUCTS

2.01 ELECTRICAL IDENTIFICATION PRODUCTS

A. Colored Adhesive Marking Tape for Wires and Cables: Self-adhesive, vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

B. Pre-tensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: Flexible acrylic bands sized to suit raceway diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.

C. Underground Line Marking Tape: Permanent, bright colored, continuous printed, plastic tape compounded for direct-burial service not less than 6 inches wide by 4 mils thick. Printed legend indicative of general type of underground line below.

D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with pre-printed numbers and letter.

E. Aluminum, Wraparound Cable Marker Bands: Bands cut from 0.014-inch-thick aluminum sheet, fitted with slots or ears for securing permanently around wire or cable jacket or around groups of conductors. Provide for legend application with stamped letters or numbers.

F. Engraved, Plastic Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners.

G. Baked Enamel Warning and Caution Signs for Interior Use: Pre-printed aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

H. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, nonfading, pre-printed cellulose acetate butyrate signs with 20-gauge galvanized steel backing, with colors, legend, and size appropriate to location. Provide 1/4-inch grommets in corners for mounting.

I. Fasteners for Plastic Laminated and Metal Signs: Self-tapping stainless steel screws or Number 10/32 stainless steel machine screws with nuts and flat and lock washers.

J. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18 inch minimum width, 50-pound minimum tensile strength, and suitable for a temperature range from minus 50 to 350 degrees F. Provide ties in specified colors when used for color coding.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification Work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by Code.

B. Underground Electrical Line Identification: During trench backfilling for exterior nonconcrete encased underground power, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench, do not exceed an overall width of 16 inches; install a single line marker.

C. Install line marker for underground wiring, both direct buried and in raceway.

D. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the Project secondary electrical system following OWNER's method of phase identification or as follows:

Phase	480/277 Volts
A	Yellow
B	Brown
C	Orange
Neutral	White
Ground	Green

E. Wiring Standards:
1. 480/277 Volt, 3-Phase Power:
   a. Brown.
   b. Orange.
   c. Yellow.
   d. Grey Neutral.
2. 208 Volt, 3-Phase Power:
   a. Black.
   b. Red.
   c. Blue.

3. 240/120 Volt, 1-Phase Power:
    a. Black.
    b. Red.
    c. White Neutral.
4. Motor Leads, Control Cabinet/MCC:
    a. Black, numbered L1-T1, etc.
5. Control Wiring:
    a. White Control circuit neutral
    b. Orange Control circuit wiring that remains energized when the main disconnect is opened.
    c. Blue + DC.
    d. Gray - DC
    e. Green Ground.

F. Use conductors with color factory applied entire length of conductors except as follows:
    1. The following field applied color coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
        a. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last 2 laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
        b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply 3 ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

G. Power Circuit Identification: Securely fasten identifying metal tags of aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-pound test monofilament line or one-piece self-locking nylon cable ties.

H. Install wire/cable designation tape markers at termination points, splices, or junctions in each circuit. Circuit designations shall be as indicated on Drawings.

END OF SECTION

SECTION 16090 - DEMOLITION AND EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Limited scope general construction materials and methods for application with electrical installations as follows:
   1. Selective Demolition including:
      a. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
      b. Dismantling electrical materials and equipment made obsolete by these installations.
   2. Excavation for underground utilities and services, including underground raceways, vaults, and equipment.

1.02 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following Project conditions apply:
   1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
   2. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Conditions Affecting Excavations: The following Project conditions apply:
   1. Maintain and protect existing building services which transit the area affected by selective demolition.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
   3. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. OWNER will not be responsible for interpretations or conclusions drawn from this information.
   4. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
   5. Remove existing underground utilities indicated to be removed.
      a. Uncharted or Incorrectly Charted Utilities: Contact utility owner immediately for instructions.
      b. Provide temporary utility services to affected areas. Provide minimum of 48-hour notice to ENGINEER prior to utility interruption.
   6. Use of explosives is not permitted.

1.03 SEQUENCING AND SCHEDULING

A. Coordinate the shutoff and disconnection of electrical service with OWNER and utility company.

B. Notify ENGINEER at least 5 days prior to commencing demolition operations.

C. Perform demolition in phases as indicated.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 SELECTIVE DEMOLITION

A. Demolish, remove, demount, and disconnect abandoned electrical materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing electrical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to location designated for storage.

C. Disposal and Clean Up: Remove from Site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. Electrical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
   1. Inactive and obsolete raceway systems, controls, and fixtures.
   2. Raceways embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings.

E. Perform cutting and patching required for demolition in accordance with Section 01730.

3.02 EXCAVATION

A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.

B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

C. Remove and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

D. Install sediment and erosion control measures in accordance with local codes and ordinances.

E. Dewatering: Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding Project Site and surrounding area.
   1. Do not allow water to accumulate in excavations. Remove to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.

2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

F. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
   1. Locate and retail soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
   2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

G. Excavation for Underground Vaults and Electrical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
   1. Excavate, by hand, areas within drip line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
   2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

H. Trenching: Excavate trenches for electrical installations as follows:
   1. Excavate trenches to uniform width, sufficiently wide to provide ample working room and minimum of 6 to 9 inches clearance on both sides of raceways and equipment.
   2. Excavate trenches to depth indicated or required.
   3. Limit length of open trench to that in which installations can be made and trench backfilled within same day.
   4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.

I. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F (1 degree C).

J. Backfilling and Filling. Place soil materials in layers to required subgrade elevations for each area classification listed below:
   1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
   2. Under building slabs, use drainage fill materials.
   3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
   4. For raceway less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation of raceways, provide a 4-inch-thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
   5. Other areas, use excavated or borrowed materials.

K. Backfill excavations as promptly as work permits, but not until completion of following:
   1. Inspection, testing, approval, and locations of underground utilities have been recorded.
   2. Removal of concrete formwork.
   3. Removal of shoring and bracing, and backfilling of voids.
   4. Removal of trash and debris.

L. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

M. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

N. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.

O. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
   1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
      a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact to 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
      b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
      c. Other Areas: Compact 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
   2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during or subsequent to compaction operations.

P. Subsidence. Where subsidence occurs at electrical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

END OF SECTION

SECTION 16120 - WIRES AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:
   1. Low-Voltage Wire and Cable.
   2. Medium-Voltage Cable.
   3. Instrument Cable.
   4. Local Area Network Wiring (LAN).

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Include Shop Drawings of wires, cables, connectors, splice kits, and termination assemblies.

B. Reports of field tests prepared as noted in Section 01600.

1.03 QUALITY ASSURANCE

A. UL Compliance: Provide components which are listed and labeled by UL. For cables intended for use in air handling space comply with applicable requirements of UL Standard 710, "Test Method for Fire and Smoke characteristics of cables used in Air Handling Spaces."

B. NEMA/ICEA Compliance: Provide components which comply with following standards:
   1. NEMA WC 70-1999/ICEA S-95-658-1999, Nonshielded Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
   2. NEMA WC 71-1999/ICEA S-96-659-1999, Standard for Nonshielded Cables Rated 2,001-5,000 Volts for use in the Distribution of Electrical Energy.
   3. NEMA WC 74-2000/ICEA S-93-639, 5-46 kV Shielded Power Cable for use in the Transmission and Distribution of Electrical Energy.

C. IEEE Compliance: Provide components which comply with the following standard.
   1. Standard 82, Test procedures for Impulse Voltage Tests on Insulated Conductors.

D. Network Wiring Experience: CONTRACTOR must be able to prove to the satisfaction of OWNER that it has significant experience in the installation of Local Area Network cable systems. Installation must include installation of Network cable, cable termination, knowledge of interconnect equipment, and a thorough knowledge of testing procedures.

E. Labeling: Handwritten labels are not acceptable. All labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or typewritten onto adhesive labels. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be of a color contrasting with the label such that is may be easily read. If labeling tape is utilized, the font color shall contrast with the background. Patch panels shall exhibit workstation numbers or some type of location identifier, in sequential order, for all workstations or devices attached. Each Network cable segment shall be labeled at each end with its respective identifier.

F. Network Wiring Interconnect Equipment (Patch Panels): Interconnect equipment shall be used in all Local Area Network cable installations. Patch panels shall be mounted in the equipment racks or panel mounted. Interconnect equipment mounted in racks shall be affixed to the rack by at least 4 screws. All interconnect devices shall be assembled and installed in accordance with the manufacturer's instructions and recommendations.

G. Patch Cords: Patch cords shall be provided for each Local Area Network port on the patch panel. Patch cords shall meet or exceed technical specifications of all installed Local Area Network cable. Patch cord connectors shall be matched with patch panel connector type and network module connector type as required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Low-Voltage Wire and Cable:
      a. American Insulated Wire Corp.
      b. General Cable.
      c. The Okonite Co.
      d. Southwire Co.
   2. Connectors for Low-Voltage Wires and Cable Conductors:
      a. AMP.
      b. O-Z/Gedney Co.
      c. Square D Company.
      d. 3M Company.
   3. Medium-Voltage Cable:
      a. American Insulated Wire Corp.
      b. General Cable.
      c. Kerite Co.
      d. The Okonite Co.
      e. Prysmian Cables & Systems.
      f. Southwire Co.
   4. Medium-Voltage Cable Splicing and Terminating Products and Accessories:
      a. Adelet-PLM.
      b. Amerace Corp.
      c. Electrical Products Division 3M.
      d. G&W Electric Co.
      e. M.P. Husky Corp.
      f. Raychem Corp.
      g. RTE Components.
   5. Instrument Cable:
      a. Belden (Trade Nos. 1120A and 1118A).
   6. Local Area Network Cable:
      a. Belden 7882A/7883A, or equal.

2.02 LOW-VOLTAGE WIRES AND CABLES

A. Conductors: Provide stranded conductors conforming to ASTM Standards for concentric stranding, Class B. Construction of wire and cable shall be single conductor (1/c) unless multiconductor cable is shown by notation in form (x/c) where x indicates the number of separate insulated conductors per cable.

B. Conductor Material: Copper. Minimum size power wire shall be No. 12 AWG.

C. Insulation: Provide RHW/USE insulation for power conductors used in single- and 3-phase circuits with more than 120 volts to ground. Provide RHW/USE, XHHW, or THWN/THHN insulation for power conductors used in single- and 3-phase circuits with 120 volts or less to ground
   1. Provide RHW, THHN/THWN, or XHHW insulation for grounding conductors installed in raceways.
   2. Provide THHN/THWN insulation for control conductors.

2.03 CONNECTORS FOR LOW-VOLTAGE WIRES AND CABLES

A. Provide UL listed factory fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types, and classes for applications and services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

2.04 MEDIUM-VOLTAGE CABLE

A. Cable shall be single-conductor type, size as indicated, and conforming to UL Standard 1072, "Medium Voltage Power Cables."

B. Cable shall be ethylene propylene rubber (EPR) insulated and shall conform to NEMA Standard WC 74-2000 (ICEA S-93-639) "5-46 kV Shielded Power Cable for use in the Transmission and Distribution of Electrical Energy."

C. Conductors: Class B stranded, annealed copper.

D. Conductor Shield: Extruded, semiconducting.

E. Insulation Shield: Extruded, semiconducting.

F. Concentric Neutral: Evenly spaced, annealed, coated, solid copper wires applied concentrically over semiconducting insulation shield. Individual wires shall be No. 14 AWG minimum. Concentric neutral ampacity shall be not less than 1/3 the ampacity of central conductor.

G. Metallic Shielding: Copper shielding tape, helically applied over semiconducting insulation shield or evenly spaced solid copper wires applied concentrically over semiconducting insulation shield.

H. Cable Jacket: Sunlight-resistant PVC, cross-linked polyolefin, or chlorosulfonated polyethylence (hypalon).

I. Cable Voltage Rating: 5 kV phase to phase.

J. Cable Voltage Rating: 8 kV phase to phase.

K. Cable Voltage Rating: 15 kV phase to phase.

L. Cable Voltage Rating: 25 kV phase to phase.

M. Cable Voltage Rating: 28 kV phase to phase.

N. Cable Voltage Rating: 35 kV phase to phase.

O. Cable Voltage Rating: 46 kV phase to phase.

2.05 MEDIUM-VOLTAGE SPLICING AND TERMINATING PRODUCTS

A. Types: Compatible with cable materials and shall be suitable for indoor or outdoor environments as required.

B. Connectors: Compression type as recommended by cable or splicing kit manufacturer for application.

C. Splicing and Terminating Kits: As recommended by manufacturer in writing for specific sizes, ratings, and configurations of cable conductor, splices, and terminations specified. Kits shall contain components required for a complete splice or termination including detailed instructions and shall be the product of a single manufacturer. Completed splices and terminations shall provide insulation equivalent to the insulation class of cable it connects and maintain current carrying capacity and mechanical strength of cable.

2.06 INSTRUMENT CABLE

A. Instrument Cable: 600 volt minimum insulated shielded cable with two or more twisted No. 16 or No. 18AWG stranded copper conductors; PVC, nylon, or polyethylene outer jacket; and 100 percent foil shielding.

2.07 LOCAL AREA NETWORK CABLE

A. Category 6 (Ethernet) Data and Patch Cable:
   1. Paired, 4-pair, 24 AWG, solid bare copper conductors with polyethylene insulation, overall aluminum foil-polyester tape shield with 24 AWG stranded tinned copper drain wire, 100 percent shield coverage, PVC jacket.
   2. UL verified to Category 6.
   3. Provide plenum rated cable where installed exposed.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. Prior to energizing, check installed 480 volt, 3-phase power circuits and higher wires and cables with a 1,000-volt megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Minimum acceptable megohm meter reading is 100 megohms held at a constant value for 15 seconds. A certified copy of megohm meter tests shall be submitted to ENGINEER. Test reports shall include ambient temperature and humidity at time of testing. Notify ENGINEER 48 hours prior to test with schedule.

B. Medium-Voltage Cable Tests shall include high-potential test of cable and accessories and such tests and examinations required to achieve specified objectives. Where new cables are spliced to existing cables, high-potential test shall be performed on the new cable prior to splicing. After test results for new cables are approved and splice is made, an insulation resistance test and continuity test on the length of cable including the splice with existing cables being tested to the nearest disconnect point.

C. Local Area Network (LAN) Cable Tests: Testing of all cable segments shall be completed in compliance with EIA/TIA-568-B.1 Standards. Testing shall be done by CONTRACTOR with at least 5 years of experience in testing Network cabling systems.
   1. TESTING: CONTRACTOR shall test each network cable segment. **OWNER reserves the right to have representation present during all or a portion of the testing process. CONTRACTOR must notify OWNER 5 days prior to commencement of testing**. If OWNER elects to be present during testing, test results will only be acceptable when conducted in the presence of OWNER.
   2. DOCUMENTATION (Network Cable): CONTRACTOR shall provide documentation to include test results and as-built Drawings. Network Cable Results: Handwritten results are acceptable provided the test is neat and legible. Copies of test results are not acceptable. Only original signed copies will be acceptable.
      a. Each cable installed shall undergo complete testing in accordance with TIA/EIA-568-B.1 to guarantee performance to this Standard.
      b. All required documentation shall be submitted within 30 days at conclusion of the project to OWNER.
      c. Test Criteria: Pass rate to conform to latest TIA/EIA-568-B.1 Standards that incorporate link performance testing through entire path, including cable, couplers, and jumpers.
   3. ACCEPTANCE: Acceptance of the Data Communications System, by OWNER, shall be based on the results of testing, functionality, and receipt of documentation.

D. Reports (non-LAN cable): Testing organization shall maintain a written record of observations and tests, report defective materials and workmanship, and retest corrected defective items. Testing organization shall submit written reports to ENGINEER.

END OF SECTION

SECTION 16130 - RACEWAYS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Raceways for electrical wiring. Types of raceways in this Section include the following:
   1. Flexible metal conduit.
   2. Liquidtight flexible conduit.
   3. Underground plastic utilities duct.
   4. Rigid metal conduit.
   5. Rigid nonmetallic conduit.
   6. Surface raceways.
   7. PVC externally coated rigid metal conduit.
   8. Fiberglass reinforced conduit.
   9. Aluminum conduit.
   10. Wireway.
   11. Conduit bodies.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product data for the following products:
      a. Surface raceway and fittings.
      b. Wireway and fittings.
      c. Conduit.
      d. Conduit bodies.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
   2. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL, ETL, or CSA.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in Work include:
   1. Conduit:
      a. Allied Tube.
      b. Carlon.
      c. Johns Manville.

d. Occidental Coatings.
e. Orangeburg.
f. Perma-Cote Industries.
g. Republic Steel.
h. Robroy Industries.
i. Steelduct Co.
j. Triangle Conduit.
k. Wheatland Tube.
l. Youngstown Sheet and Tube.

2. Liquidtight Conduit:
   a. Anamet, Inc.
   b. Carlon.
   c. Electric-Flex.
   d. Thomas and Betts.
3. Conduit Bodies:
   a. Adalet-PLM.
   b. American Electric.
   c. Appleton Electric Co.
   d. Carlon.
   e. Crouse-Hinds Division, Cooper Industries, Inc.
   f. Delta Industrial Products.
   g. Killark Electric Mfg. Co.
   h. Kraloy Products Co.
   i. O-Z/Gedney Co.
   j. Perma-Cote Industries.
   k. Robroy Industries.
   l. Spring City Electrical Mfg. Co.
4. Conduit Thread Paint:
   a. CRC Chemicals, USA.
   b. Sherwin Williams.
   c. ZRC Chemical Products Co.
5. Wireway:
   a. Alrey-Thompson Co.
   b. Anchor Electric Co.
   c. Hoffman Engineering Co.
   d. Keystone/Rees, Inc.
   e. Robroy Industries, Inc.
   f. Square D Company.
6. Surface Metal Raceway:
   a. Allied Tube & Conduit.
   b. B-Line Systems, Inc.
   c. Butler Mfg. Co.
   d. Hoffman Engineering Co.
   e. Isoduct Energy Systems.
   f. Isotrol Systems.
   g. Keystone/Rees, Inc.
   h. Square D Company.
   i. The Wiremold Co.
7. Surface Nonmetallic Raceway:
   a. Anixter Brothers, Inc.
   b. Hoffman Engineering Co.

c. Hubbell, Inc.
d. Panduit Corp.
e. Premier Telecom Products, Inc.
f. Thermotools Co.
g. The Wiremold Co.

2.02 METAL CONDUIT AND TUBING

A. Rigid Metal Conduit: ANSI C 80.1, hot-dip galvanized.

B. PVC Externally Coated Rigid Metal Conduit and Fittings: ANSI C 80.1 and NEMA RN 1., Type 40, 40 mil nominal coating and thickness. The bond of the PVC to the substrate shall be stronger than the tensile strength of the PVC.

C. Flexible Metal Conduit: UL 1, zinc-coated metal.

D. Liquidtight Flexible Metal Conduit and Fittings: UL 360. Fittings shall be specifically approved for use with this raceway.

E. Rigid metal aluminum conduit: ANSI C 80.5, 6063 alloy in temper designation T-1.

2.03 NONMETALLIC CONDUIT AND DUCTS

A. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 and UL 651, Schedule 40 or 80 PVC.

B. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

C. Underground PVC and ABS Plastic Utilities Duct: NEMA TC 6, Type I for encased burial in concrete, Type II for direct burial.

D. PVC and ABS Plastic Utilities Duct Fittings: NEMA TC 9; match to duct type and material.

E. Liquidtight Flexible Nonmetallic Conduit and Fittings: UL 1660. Fittings shall be specifically approved for use with this raceway.

F. Fiberglass-Reinforced Conduit and Fittings: CSA B196.1 and B1089 A.

2.04 CONDUIT BODIES

A. Provide matching gasketed covers secured with corrosion-resistant screws. Use cast covers in NEMA 4 areas and stamped steel covers in NEMA 1 and 12 areas. Use nonmetallic covers in NEMA 4X areas and threaded, ground joint covers in NEMA 7 and NEMA 9 areas.

B. Metallic Conduit and Tubing: Use metallic conduit bodies as follows:
1. Rigid Metal Conduit: Use cast or malleable iron conduit bodies with zinc electroplating, aluminum enamel or lacquer finish, and threaded hubs.
2. Intermediate Metal Conduit: Use cast or malleable iron conduit bodies with zinc electroplating, aluminum enamel or lacquer finish, and threaded hubs.
3. Electrical Metallic Tubing: Use cast or malleable iron conduit bodies with zinc electroplating, aluminum enamel or lacquer finish, and compression type or setscrew connectors.

4. PVC Externally Coated Rigid Metal Conduit: Use hot-dipped galvanized or cadmium-plated cast or malleable iron conduit bodies with threaded hubs factory PVC-coated. Field application of PVC coating to conduit bodies is not acceptable. Secure covers using PVC encapsulated or stainless steel screws.
5. Nonmetallic Conduit and Tubing: Use nonmetallic conduit bodies conforming to UL 514 B.
6. NEMA 7 and NEMA 9 Areas: Use materials conforming to UL standards for the area.

2.05 WIREWAYS

A. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC.

B. Wireway covers shall be hinged type.

2.06 SURFACE RACEWAYS

A. Sizes and channels as indicated. Provide fittings that match and mate with raceway.

B. Surface Metal Raceway: Construct of galvanized steel with snap-on covers, with 1/8-inch mounting screw knockouts in base approximately 8 inches o.c. Finish with manufacturer's standard prime coating suitable for painting. Provide raceways of types suitable for each application required.

C. Surface Nonmetallic Raceway: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color. Raceway and system components shall meet UL 94 requirements for nonflammable, self-extinguishing characteristics.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16135 - CABINETS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other Sections. Types of products specified in this Section include:
   1. Outlet and device boxes.
   2. Pull and junction boxes.
   3. Terminal boxes.
   4. Bushings.
   5. Locknuts.
   6. Conduit hubs.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Shop Drawings for floor boxes and boxes, enclosures, and cabinets that are to be shop-fabricated, (nonstock items). For shop-fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.
   2. Product data for boxes, fittings, cabinets, and enclosures.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. UL Listing and Labeling: Items provided under this section shall be listed and labeled by UL.
   2. NEMA Compliance: Comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Outlet Boxes, Concealed Conduit System:
      a. Adalet-PLM Div., Scott Fetzer Co.
      b. Appleton Electric, Emerson Electric Co.
      c. Bell Electric, Square D Company
      d. Eagle Electric Mfg. Co., Inc.
      e. Midland-Ross Corp.
      f. OZ/Gedney, General Signal Co.
      g. Pass and Seymour, Inc.

h. RACO Div., Harvey Hubbell, Inc.
i. Thomas & Betts Co.

2. Outlet Boxes, Exposed Conduit System:
   a. Appleton Electric, Type JB, GS, or SHE.
   b. Crouse-Hinds, Type GS or GRF.
3. Device Boxes, Concealed Conduit Systems:
   a. Adalet-PLM Div., Scott Fetzer Co.
   b. Appleton Electric; Emerson Electric Co.
   c. Bell Electric, Square D Company.
   d. Eagle Electric Mfg. Co., Inc.
   e. Midland-Ross Corp.
   f. OZ/Gedney, General Signal Co.
   g. Pass and Seymour, Inc.
   h. RACO Div., Harvey Hubbell, Inc.
   i. Thomas & Betts Co
4. Device Boxes, Exposed Conduit System:
   a. Appleton Electric, Type FS/FD.
   b. Crouse-Hinds, Type FS/FD.
5. Junction and Pull Boxes, Concealed System:
   a. Adalet-PLM Div., Scott Fetzer Co.
   b. Appleton Electric, Emerson Electric Co.
   c. Arrow-Hart Div., Crouse-Hinds Co.
   d. Bell Electric, Square D Company.
   e. GTE Corporation.
   f. Keystone Columbia, Inc.
   g. OZ/Gedney Co.; General Signal Co.
   h. Spring City Electrical Mfg. Co.
6. Junction and Pull Boxes, Exposed Conduit System:
   a. Appleton Electric, Type FS/FD.
   b. Crouse-Hinds, Type FS/FD.
7. Terminal Boxes:
   a. AMFCO.
   b. Boss.
   c. Hoffman.
   d. Keystone.
   e. Hope.
8. Bushings, Knockout Closures, Locknuts, and Connectors:
   a. Adalet-PLM Div., Scott Fetzer Co.
   b. AMP, Inc.
   c. Arrow-Hart Div., Crouse-Hinds Co.
   d. Appleton Electric Co., Emerson Electric Co.
   e. Bell Electric; Square D Co.
   f. Midland-Ross Corp.
   g. Midwest Electric, Cooper Industries, Inc.
   h. OZ/Gedney Co., General Signal Co.
   i. RACO Div., Harvey Hubbell, Inc.
   j. Thomas & Betts Co., Inc.

2.02 CABINETS, BOXES, AND FITTINGS - GENERAL

A. Outlet Boxes: Suitable for the conduit system installation as follows:
   1. Exposed Conduit: Provide cast outlet boxes finished with aluminum lacquer or enamel. Provide cast metal covers with neoprene gaskets for NEMA 12 and 4 areas and undesignated areas.
      a. Exception: Provide non-metallic outlet boxes for NEMA 4X areas. Provide the appropriate explosion-proof rating for outlet boxes installed in NEMA 7 and NEMA 9 areas. Provide factory PVC-coated or 316 stainless steel boxes where PVC-coated conduit is specified.
   2. Concealed Conduit: Provide 316 stainless 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. Provide cast metal outlet boxes for exterior outlets.

B. Device Boxes: Suitable for the conduit system as follows:
   1. Exposed Conduit: Provide 316 stainless device boxes finished with aluminum lacquer or enamel. Provide exterior mounting lugs on device boxes.
      a. Exception: Provide non-metallic outlet boxes for NEMA 4X areas. Provide appropriate explosion-proof rating for device boxes installed in NEMA 7 and NEMA 9 areas. Provide factory PVC-coated or 316 stainless steel device boxes where PVC-coated conduit is specified.
   2. Concealed Conduit: Provide 316 stainless 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. Provide cast metal device boxes for exterior devices.

C. Junction and Pull Boxes: Suitable for the conduit system installation as follows:
   1. Exposed Conduit: For pull and junction boxes provide 316 stainless steel hinged boxes. Provide exterior mounting lugs. Grind exposed edges smooth or roll edges to prevent scuffing of wire during installation. Provide a continuous neoprene or rubber gasket cemented to the box cover where it contacts the box body.
      a. Exceptions: Provide nonmetallic pull and junction boxes in NEMA 4X areas. Provide appropriate explosion-proof construction for boxes located in NEMA 7 and NEMA 9 areas. Provide factory PVC-coated or 316 stainless steel boxes for areas where PVC conduit is used.
   2. Concealed Conduit: Provide 316 stainless 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.

D. Terminal Boxes: Provide compression lug type terminal strips in each terminal box with a minimum of 20 percent spare terminals. Provide appropriate NEMA enclosure rating for area in which terminal box is installed. Boxes to be 316 stainless steel.

E. 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. Provide watertight hubs on conduits terminated at 316 stainless steel enclosures in NEMA 12 and Nema 4 areas.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16139 - VAULTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Extent of underground concrete encased conduit (ductbank) vault, manhole, and handhole work as indicated by Drawings, and is hereby defined to include those units which are utilized exclusively for installation of instrumentation, communication, and control media and equipment; and electrical power cables, wires, and equipment.

B. Types of vaults, manholes, and handholes in this Section include, but are not limited to:
   1. Utility vaults.
   2. Electrical manholes.
   3. Electrical handholes.
   4. Concrete encased conduit (ductbank).

C. Related Work in Other Sections:
   1. Excavation and backfill required in connection with vaults, manholes, and handholes.
   2. Concrete Work required in connection with vaults, manholes, and handholes.
   3. Waterproofing and dampproofing of vaults, manholes, and handholes.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

   1. Manufacturer's Data: Submit manufacturer's data on concrete encased conduit vault, manhole, and handhole components and associated specialty products.
   2. Submit Shop Drawings for vault system, showing raceway types and sizes, locations, and elevations for horizontal runs. Include details of underground structures, accessories, fittings, and connections.

1.03 QUALITY ASSURANCE

A. Prefabricators: Firms regularly engaged in manufacture of factory fabricated vaults, manholes, and handholes, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:
   1. ANSI Compliance: Comply with requirements of ANSI C2, "National Electrical Safety Code," pertaining to construction and installation of concrete encased conduit vaults, manholes, and handholes.
   2. ASTM Compliance: Comply with applicable requirements of American Society for Testing and Materials (ASTM) standards pertaining to construction and materials for vaults, manholes, and handholes.
   3. UL Compliance: Comply with applicable requirements of Standard 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors." Provide vault, manhole, and handhole accessories which are UL listed and labeled.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

B. Prefabricated Units:
   1. Advance Concrete.

C. Manhole Frames and Covers:
   1. James B. Clow & Sons.
   2. Neenah Foundry Co.

2.02 MATERIALS FOR FIELD FABRICATED UNITS

A. Concrete Materials: Comply with Division 3 requirements for applicable product requirements of concrete materials, except as otherwise indicated.

B. Concrete Masonry Units: ASTM C 139.

C. Masonry Mortar: ASTM C 270, Type M:
   1. For minor amounts of mortar comprising less than 2.0-cubic-foot packaged mortar materials complying with ASTM C 387, Type M, may be substituted at CONTRACTOR's option.

D. Manhole Frames and Covers: Grey cast iron, ASTM A 48, Class 30B:
   1. Dip coat frames and covers in black asphalt paint. Provide 30-inch-diameter openings for vaults and manholes carrying low-voltage circuits. Provide 36-inch-diameter openings for vaults and manholes carrying medium-voltage circuits.
   2. Furnish covers with cast-in legend "ELECTRIC" on roadway face.

E. Vault and Manhole Steps: Grey cast iron, ASTM A 48, Class 30B, integrally cast into vault and manhole sidewalls, unless otherwise indicated.

2.03 FACTORY FABRICATED VAULTS, MANHOLES, AND HANDHOLES

A. Concrete Vaults and Manholes: Provide watertight, precast concrete vaults and manholes in types and sizes indicated, with access knockout entrance holes for raceways and cable, cast-iron manhole access cover and frame with machined bearing surfaces, with pulling/lift irons, sump/drainage box and vertical embedded continuous slot inserts.

B. Manhole Frames and Covers: Grey cast iron, ASTM A 48, Class 30B:
   1. Dip coat frames and covers in black asphalt paint. Provide 30-inch-diameter openings for vaults and manholes carrying low-voltage circuits. Provide 36-inch diameter openings for vaults and manholes carrying medium-voltage circuits.
   2. Furnish covers with cast-in legend "ELECTRIC" on roadway face.
   3. Provide reinforced concrete for vaults and manholes with slabs designed for H-20 highway loading and walls designed for a lateral earth pressure of 80 pounds per square foot per foot of depth.

C. Handholes and Boxes: Provide handholes and boxes for pulling, splicing, and terminating conductors, in types and sizes indicated, with watertight cover and penta-head bolts and knockout access holes; equip base with sump/drainage box.
   1. Provide concrete body with cast iron cover and ring.

D. Accessories: Provide vault, manhole, and handhole accessories, including pulling-in irons, embedded cable support accessories, cable rack arms, porcelain saddles, sump pump pits, ladders, mastics, and sealants as indicated or required.

PART 3 - EXECUTION

3.01 INSPECTION

A. Installer must examine areas and conditions under which concrete encased conduit vaults, manholes, and handholes are to be installed, and notify CONTRACTOR in writing of those conditions detrimental to proper completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 UNDERGROUND CONCRETE ENCASED CONDUIT

A. Support conduit to be encased on approved spacers at the dimensions shown on Drawings.

B. Reinforce concrete encasement as indicated.

C. Slope duct runs a minimum of 0.5 percent in the direction indicated.

D. Maintain a 12-inch minimum clearance between concrete encasement and yard piping.

E. Provide 24-inch minimum clearance from top of concrete encasement to finished grade unless otherwise noted.

F. Mandrel and clean all underground conduits prior to cable installation.

3.03 INSTALLATION OF VAULTS, MANHOLES, AND HANDHOLES

A. Install vaults, manholes, and handholes as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that vaults, manholes, and handholes comply with requirements.

B. Set manhole frames and covers flush with sidewalk, pavement, or ground surface. In gravel driveways set covers 4 inches below surface.

C. Coordinate with other Work, including electrical raceway and wiring Work, as necessary to interface installation of vaults, manholes, and handholes with other Work.

3.04 INSTALLATION OF FIELD FABRICATED UNITS

A. Fabricate vaults, manholes, and handholes, of types and sizes indicated, watertight, and equip with manhole metal access cover, steps, access holes for raceways and cables, sump/drainage box, and bolting inserts.

B. Masonry Construction Manholes:
   1. Use concrete masonry units to construct masonry manholes and vaults.
   2. Construct manholes and vaults in sizes and shapes indicated.
   3. Mix mortar with only enough water for workability. Retempering of mortar is not permitted. Keep mortar mixing and conveying equipment clean. Do not deposit mortar upon, or permit contact with, the ground.
   4. Lay masonry in mortar to form full-bed joints, with end and side joints formed in one operation, and with bed and vertical joints not more than 5/8-inch wide. Protect fresh masonry from freezing and also from too rapidly freezing and from too rapidly drying.
   5. Apply a 1/2-inch-thick mortar coating on both interior and exterior wall surfaces.
   6. Where manholes are installed in pavements, set tops of frames and covers flush with finish surface. Elsewhere, set tops 3 inches above finish surface unless otherwise indicated.
   7. Use an epoxy bonding compound where manhole steps are mortared into masonry walls.

C. Cast-In-Place Concrete Manholes:
   1. Use cast-in-place concrete to construct manholes and vaults.
   2. Construct manholes and vaults of sizes and shapes indicated.
   3. Dampproofing and Waterproofing:
      a. Coordinate dampproofing and waterproofing Work with installation of field fabricated units as necessary for proper interface.
      b. Install dampproofing and waterproofing materials as indicated.

3.05 INSTALLATION OF FACTORY FABRICATED UNITS

A. Install vaults, manholes, and handholes as indicated, in accordance with manufacturer's written instructions and recognized industry practices to ensure that vaults, manholes, and handholes comply with requirements and serve intended purposes.

B. Precast Concrete Units: Place precast concrete sections as indicated. Where units occur in pavements, set tops of frames and covers flush with finish surface, unless otherwise indicated. Use epoxy bonding compound where steps are mortared into unit walls.
   1. Install rubber joint gasket, complying with ASTM C 443, at joints between sections.
   2. Apply bituminous mastic coating at joints between sections.
   3. Coordinate dampproofing and waterproofing Work with installation of precast concrete units as necessary for proper interface.
   4. Install dampproofing and waterproofing materials as indicated.

3.06 BACKFILLING

A. Delay backfilling of excavations surrounding vaults, manholes, and handholes until after initial inspection has been completed.

3.07 GROUNDING AND BONDING

A. Provide equipment grounding and bonding connections for exposed metal parts in vaults, manholes, and handholes as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

END OF SECTION

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:
   1. Receptacles.
   2. Ground fault circuit interrupter receptacles.
   3. Plugs.
   4. Plug connectors.
   5. Telephone and network outlets.
   6. Wall plates.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product data for each type of product specified.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Bryant Electric Co., Division of Hubbell Corporation.
   2. Cooper Wiring Devices.
   3. Hubbell, Inc.
   4. Leviton Manufacturing Co., Inc.
   5. Pass and Seymour, Inc.

2.02 WIRING DEVICES

A. Provide devices which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Provide ivory color devices and wall plates except as otherwise indicated.

B. Receptacles: Provide specification grade or heavy-duty grounding receptacles with the NEMA rating shown on Wiring Device Schedule on Drawings. Comply with UL 498 and NEMA WD1.

C. Receptacles, Industrial Heavy-Duty: Provide pin and sleeve design receptacles conforming to UL 498. Comply with UL 1010 where installed in hazardous locations. Provide features indicated.

D. Ground Fault Interrupter (GFI) Receptacles: Provide specification grade or heavy-duty "feed-through" type ground fault circuit interrupter, with integral grounding type NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide units rated Class A, Group 1, per UL Standard 94.3.

E. Plugs: 15 amperes, 125 volts, 3-wire, grounding, armored cap plugs, parallel blades with cord clamp, and 0.4-inch cord hole; match NEMA configuration with power source's.

F. Plug Connectors: 15 amperes, 125 volts, bakelite-body armored connectors, 3-wire, grounding, parallel blades, double wipe contact, with cord clamp, and 0.4-inch cord hole, match NEMA configuration to mating plug's. Arrange as indicated.

G. Telephone and Network Outlets: Telephone outlets shall consist of box, wall plate, and RJ-12 jack. Network outlets shall consist of box, wall plate, and RJ-45 jack. Network outlet shall comply with requirements of CAT-5E cabling systems. Wall plates shall match color and style of receptacle and switch wall plates used throughout the Project.

H. Provide Appleton generator recpeticle and pin sleeve connector, including 20ft cable. Refer to sheet E-101 for additional requirements.

2.03 WIRING DEVICE ACCESSORIES

A. Wall plates: Single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plates with engraved legend where indicated. Exterior receptacle covers shall provide rainproof protection while in use. Conform to requirements of Section 16075. Provide plates possessing the following additional construction features:
   1. NEMA 12 and Unclassified Areas. Material and Finish: 0.04-inch-thick stainless steel, or 0.04-inch-thick brass, chrome plated.
   2. NEMA 4 Area Material and Finish: Cast screw cap and cover plate for receptacles. Cast cover plate with lever or plunger operator for switches.
   3. NEMA 4X Material and Finish: Non-metallic, watertight wall plates 0.05-inch-thick aluminum, anodized.
   4. NEMA 7 and NEMA 9 Material and Finish: cast metal cover plates meeting NEC requirements for area.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16220 - MOTORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section applies, in general, to all electric or DC motor-driven equipment provided under Divisions 2 through 16 Sections. This Section shall supplement the detailed Equipment Specifications, but in cases of conflict, the Specifications indicated in this Section shall govern.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Submittals for motors shall accompany the specific equipment the motor is to be supplied with.
   2. Submit product literature for each motor.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01600, operation and maintenance manuals for items included under this Section.

1.03 QUALITY ASSURANCE

A. Electrical Codes, Ordinances, and Industrial Standards: The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment, and accessories proposed under this Contract shall conform to the National Electrical Code and to applicable State and local requirements. UL listing and labeling shall be adhered to under this Contract. Any equipment that does not have a UL, FM, CSA, or other listed testing laboratory label, shall be furnished with a notarized letter signed by the supplier stating that the equipment furnished has been manufactured in accordance with the National Electrical Code and OSHA requirements. Any additional cost resulting from any deviation from codes or local requirements shall be borne by CONTRACTOR.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, motors shall be standard design and construction. Manufacturers offering products which may be incorporated in Work include:
   1. Motors:
      a. Marathon Blue Chip Series.
      b. Siemens, Inc.
      c. General Electric Co.
      d. Reliance Electric Co.
      e. U.S. Electric Motors.

B. For motors that are integrally constructed as a piece of equipment, such as appliances, hand tools, etc., and where manufacturer would be required to redesign equipment to meet these general specifications, it is the intent to allow such standard motors to be used, provided they do not exceed 1-1/2 horsepower and are suitable for use on standard power systems.

2.02 MATERIALS

A. Shop primers shall be Tnemec "77 Chem-Prime," or equal.

B. Rust preventive compound shall be equal to Dearborn Chemical "No-Ox-ID2W," Houghton "Rust Veto 344," or Rust-Oleum "R-9".

2.03 MANUFACTURED UNITS

A. Electrical Motors: Motor design and application shall comply with current ANSI, IEEE, NEMA, and AFBMA standards and with the NEC where applicable. They shall be squirrel cage induction motors rated 60 hertz, continuous duty for use in 40 degrees C ambient temperature. Motors shall comply with NEMA MG1-1993, Rev. 1, Part 31, Definite Purpose Inverter-Fed Motors whether used with variable frequency drives or not.
   1. The motors shall be sized within their rated loads under the specified conditions without utilizing the top 15 percent of the 1.0 or 1.15 service factor. Motor sizing measured at the motor output shaft shall include all loadings on the motor. Motor loadings shall include the maximum or specified load condition of the driven equipment plus all drive losses of components, located between the motor and the driven equipment.
   2. The motor winding temperature rise shall be NEMA Standard for the class of insulation used at the rated service factor load.
   3. The motors shall be capable of handling unfiltered voltage peaks of up to 1600 volts, and rise times of 0.1 micro-seocnds.

B. Motors 50 horsepower and larger shall have embedded passive temperature switches in the windings for use in the motor control circuit that will limit the winding temperature as defined by NEMA Standard MG1-12.53 Type 1. The contact shall be normally closed and rated to operate a 120 volt AC control relay (40 VA).

C. All integral horsepower motors shall have oversize conduit boxes with clamp-type grounding terminals inside which are effectively connected to all noncurrent-carrying motor parts.

D. Multispeed motors are to be supplied with separate windings for each speed. The cost to change starters for motors supplied with reconnectable windings will be the responsibility of equipment (motor) supplier and must be coordinated with ENGINEER.

E. All explosion-proof motors shall meet NEC Class 1, Division I, Group D, requirements with T2A temperature rating.

F. Unless these general specifications are supplanted by the detailed equipment specifications, motors shall be rated and constructed as follows:
   1. Below 1/2 Horsepower: Motors shall be rated 115/230 volts, single phase, but shall be suitable for use on 208 volt power system. They shall have permanently lubricated sealed bearings (antifriction type where high radial or axial thrusts are produced by the driven equipment). Standard motors shall be totally enclosed fan cooled, totally enclosed air-over, or totally enclosed nonventilated capacitor start type as shown on Equipment Schedule(s) or specified in the equipment specifications. Totally enclosed explosion-proof motors shall be provided where required per equipment specifications section.
   2. From 1/2 to 1-1/2 Horsepower: Motors shall be rated 115/230 volts single phase or shall be rated 230/460 volts 3-phase as indicated by Equipment Schedule(s). In either case they shall be suitable for use on 208 volt power systems under their given load conditions. They shall have

bearings as in 2.03 F.1. The standard enclosures shall be totally enclosed fan cooled, totally enclosed nonventilated, totally enclosed explosion-proof, or open drip-proof as shown on Equipment Schedule(s) or specified in the equipment specifications.

3. From 2 to 200 Horsepower: Motors shall be rated 230/460 or 460 volt, 3-phase. They shall be grease lubricated, ball bearing, Class B insulated, minimum or as specified. Horizontal motors shall be open drip-proof, totally enclosed fan-cooled or totally enclosed explosion-proof (NEC, Class I, Group D) as shown on Equipment Schedule(s) or specified in the equipment specifications. Vertical motors shall meet NEMA standard open drip-proof specifications as a vertical motor when called for or totally enclosed fan cooled or totally enclosed explosion-proof as shown on Equipment Schedule(s).

G. Horizontal and vertical motors may also be weather protected, Type I, and shall have encapsulated or sealed windings.

H. Open drip-proof type motors shall have encapsulated or sealed windings when called for on Drawings or Equipment Schedules.

I. Special duty and severe environment application shall have motors which are designed specifically to meet the special conditions as specified.

J. Motors above 200 Horsepower: Motors shall be of special design as detailed in specific sections of the Specifications. All special purpose motors, such as wound-rotor, multi-speed, variable speed, etc., shall be as detailed in specific Sections of the Specifications. Motor shall be furnished with ten (10) 100-ohm (or as required to be accepted as inputs to the motor protective device) platinum RTD Type temperature sensors for the stator windings; 2 sensors per phase per winding; and 2 temperature sensors for motor bearings; 1 sensor per bearing and 1 for motor ambient temperaturre. RTD sensors shall be the 3-wire type and shall be wired to a terminal strip in a common frame mounted terminal box.

K. The following symbols will be employed on Equipment Schedule(s) to indicate the required motor enclosure and construction features:
   1. TE Totally Enclosed, may be nonventilated, fan-cooled or air-over type.
   2. TENV Totally Enclosed Nonventilated.
   3. TEFC Totally Enclosed Fan-cooled.
   4. TEEP Totally Enclosed Explosion-proof, Class I, Div. I, Group D.
   5. ODP Open Drip-proof.
   6. WPI Weather Protected Type I.
   7. E/S Encapsulated or Sealed Windings.
      a. All motors with encapsulation or sealed windings shall have a water-tight conduit box.

L. See NEMA Standard MG1 for definition of above terms.

M. Motor Efficiency: Where Equipment Schedule(s) indicate that motors shall be designed for high efficiency, they shall meet or exceed the Motor Operating Characteristics shown on High Efficiency Motor Schedule No. 16220.2, appended to this Section. Guaranteed minimum efficiency at full load shall be based on IEEE Standard 112, Test Method B. Nominal motor efficiencies are average expected values. Manufacturer's motor Shop Drawings shall indicate full compliance with the High Efficiency Motor Schedule No. 16220.2.

2.04 FABRICATION

A. Electric motors shall be shop-finished with 2 coats of enamel paint per manufacturer's recommendations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's written installation and alignment instructions.

B. Lubricate oil-lubricated bearings.

C. Provide electrical wiring and connections as specified in Division 16 Sections.

3.02 FIELD QUALITY CONTROL

A. Inspect all terminations for proper connection.

B. Check motor for proper rotation.

3.03 INSTALLATION CHECK

A. Installation Check: Manufacturer shall provide the services of a factory-trained representative to check the installation of all equipment installed in this Section. The services shall be as noted in Section 01600. Equipment supplier's representative shall revisit Site as often as necessary until all trouble is corrected and equipment installation and operation is satisfactory to ENGINEER.

B. Manufacturer's representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.

C. Inspection Report: A written report of the installation check shall be submitted to ENGINEER. The report shall be as noted under Section 01600 certifying that the equipment:
   1. Has been properly installed and lubricated;
   2. Is in accurate alignment;
   3. Is free from any undue stress imposed by any connection or anchor bolts;
   4. Has been operated under full load condition and that it operated satisfactorily to ENGINEER; and
   5. That OWNER's representative has been instructed in the proper maintenance and operation of the equipment.
   6. Furnish OWNER a copy of all test data recorded during the installation check including noise level and vibration readings.

HIGH EFFICIENCY MOTOR SCHEDULE NO. 16220.2
MOTOR OPERATING CHARACTERISTICS

		Efficiency (percent)						
		Guar.						
	RPM	Min.		Nominal		Power Factor (percent)		
HP	Syn.	Full	1/2	3/4	Full	1/2	3/4	Full
1	1800	81.5	78.1	81.0	81.5	54.2	67.3	75.8
	1200	75.5	69.5	75.6	78.5	38.4	49.4	58.3
	3600	78.5	78.4	80.2	81.5	75.3	84.4	88.8
1.5	1800	81.5	79.2	82.9	84.0	52.1	65.1	74.0
	1200	81.5	80.5	83.4	84.0	44.0	56.6	85.6
	3600	81.5	78.8	82.9	84.0	66.3	78.4	85.0
2	1800	81.5	78.8	82.6	84.0	48.9	61.7	70.0
	1200	84.0	83.0	83.6	86.5	46.6	59.6	68.0
	3600	84.0	75.4	84.3	86.5	69.7	80.0	85.6
3	1800	86.5	86.9	88.5	88.5	62.3	73.9	79.9
	1200	86.5	84.5	87.5	88.5	45.9	58.3	68.0
	3600	86.5	86.2	88.2	88.5	71.7	81.7	86.4
5	1800	88.5	84.0	88.2	88.5	68.5	79.2	84.6
	1200	86.5	85.8	88.2	88.5	50.8	63.8	71.9
	3600	86.5	82.9	86.7	88.5	75.9	84.3	88.1
7.5	1800	88.5	89.2	90.3	90.2	66.5	77.2	82.4
	1200	86.5	87.5	88.8	88.5	58.6	68.8	73.7
	3600	86.5	87.7	89.0	88.5	77.1	84.5	87.6
10	1800	88.5	89.3	90.4	90.2	67.6	77.4	81.9
	1200	88.5	89.0	90.3	90.2	60.1	70.2	74.9
	3600	88.5	82.3	87.4	90.2	81.1	87.2	90.4
15	1800	90.2	91.0	91.9	91.7	68.5	78.1	82.3
	1200	88.5	89.9	90.6	90.2	67.4	77.1	81.4
	3600	90.2	89.1	91.1	91.7	83.7	88.5	90.5
20	1800	90.2	90.9	91.9	91.7	68.9	78.1	81.8
	1200	90.2	91.0	91.0	91.7	69.8	78.5	81.9
	3600	90.2	91.6	92.0	91.7	81.9	88.6	90.6
25	1800	91.7	92.8	93.2	92.4	72.7	81.4	84.5
	1200	90.2	90.0	91.4	91.7	79.8	84.5	85.5
	3600	90.2	90.6	91.7	91.7	81.1	87.8	90.3
30	1800	91.7	92.8	93.3	93.0	71.5	80.6	84.2
	1200	90.2	91.7	92.0	91.7	78.9	85.4	86.8
	3600	90.2	89.1	91.2	91.7	83.8	88.6	89.9
40	1800	91.7	91.0	92.6	93.0	71.6	80.6	84.2
	1200	91.7	93.0	93.3	93.0	80.9	86.4	88.0
	3600	90.2	88.7	90.8	91.7	82.5	90.8	92.0
50	1800	93.0	92.4	93.7	94.1	76.4	83.7	86.3
	1200	91.7	93.0	93.3	93.0	80.9	87.3	88.9
	3600	91.7	89.9	92.0	93.0	84.9	89.9	91.6
60	1800	93.0	93.2	94.0	94.1	76.3	84.0	86.8
	1200	91.7	92.5	93.1	93.0	75.8	82.9	85.5
	3600	93.0	91.0	93.1	94.1	82.6	88.7	90.9
75	1800	93.0	92.6	93.8	94.1	76.4	83.8	86.6
	1200	93.0	93.5	94.2	94.1	75.1	82.4	84.7
	3600	93.0	91.3	93.3	94.1	86.1	89.7	91.0
100	1800	94.1	93.8	94.8	95.0	83.8	87.6	89.0
	1200	93.0	93.1	93.9	94.1	72.5	80.0	83.2
	3600	93.0	91.2	93.1	94.1	83.0	88.3	89.0
125	1800	93.7	93.5	94.6	95.0	79.2	84.6	86.0
	1200	93.0	93.5	94.2	94.1	75.2	82.3	85.2
	3600	93.0	91.8	93.4	94.1	85.3	89.3	89.1
150	1800	94.1	93.7	94.7	95.0	81.6	86.4	86.6
	1200	94.1	94.1	94.9	95.0	77.2	84.4	85.7
	3600	94.1	92.7	94.3	95.0	83.3	87.5	88.5
200	1800	94.5	94.2	94.9	95.0	80.0	85.6	86.7
	1200	94.3	94.2	94.9	95.0	78.0	84.5	86.0
	3600	94.3	94.8	95.5	95.3	83.0	87.5	88.5
250	1800	94.3	96.0	96.0	95.8	79.5	85.6	83.0

END OF SECTION

SECTION 16270 - TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Types of transformers specified, and include the following:
   1. Dry-type transformers (lighting transformers).

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product Data: Submit manufacturer's technical product data, including rated kVA, frequency, primary and secondary voltages, percent taps, polarity, impedance and average temperature rise above 40 degrees C ambient temperature, sound level in decibels, and standard published data.
   2. Submit manufacturer's Drawings indicating dimensions and weight loadings for transformer installations.
   3. Wiring Diagrams: Submit wiring diagrams for power distribution transformers.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. NEMA Compliance: Comply with NEMA Standard Pub/Nos. ST 20, "Dry-Type Transformers for General Applications," TR 1, and TR 27.
   2. UL Compliance: Comply with applicable portions of ANSI/UL 506, "Safety Standard for Specialty Transformers. Provide power/distribution transformers and components which are UL listed and labeled.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Acme Electric Corporation.
   2. Cutler-Hammer.
   3. General Electric Company.
   4. Hevi-Duty Electric Div., General Signal Corp.
   5. Square D Company.

2.02 POWER/DISTRIBUTION TRANSFORMERS

A. Except as otherwise indicated, 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.

B. 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, 10 kV BIL, 4.0 percent impedance, with 480 volts primary and 240/120 volts secondary; or K-rated 13 three-phase, 60 hertz, 10 kV BIL, 4.0 percent impedance with 480-volts delta connection primary and 208/120 volts secondary wye connected. Provide primary winding with 4 taps; 2 to 2-1/2 percent increments above and below full-rated voltage for de-energized tap-changing operation. Insulate with Class 150 or 220 degree C insulation and rate for continuous operation at kVA, and limit transformer temperature rise to maximum of 115 or 150 degrees C, respectively. 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 degrees C when transformer is operating continuously at rated load with ambient temperature of 40 degrees 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.

C. Finishes: Coat interior and exterior surfaces of transformer, including bolted joints, with manufacturer's standard color baked-on enamel.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16410 - CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.01 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product data for each type of product specified.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Sections 01600 and 13410, operation and maintenance manuals for items included under this Section, including circuits and motor disconnects.

1.02 QUALITY ASSURANCE

A. Codes and Standards:
   1. Electrical Component Standards: Provide components which are listed and labeled by UL. Comply with UL Standard 98 and NEMA Standard KS 1.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Allen-Bradley.
   2. Square D Company.
   3. Eaton

2.02 CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. Provide NEMA 4, 4X, 7, 9, or 12 enclosure to match the rating of the area in which switch is installed. For motor and motor starter disconnects through 100 horsepower, provide units with horsepower ratings suitable to loads. For motor and motor starter disconnects above 100 horsepower, clearly label switch, "DO NOT OPEN UNDER LOAD."

B. Fusible Switches: (Heavy-duty) switches, with fuses of classes and current ratings indicated. See Section "Fuses" for specifications. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses.

C. Circuit Breaker Switches: Where individual circuit breakers are required, provide factory-assembled, molded-case circuit breakers with permanent instantaneous magnetic and thermal trips in each pole, 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 indication. Provide push-to-trip feature for testing and exercising circuit breaker trip mechanism. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees C. Provide with AL/CU-rated mechanical screw type removable connector lugs.

D. Non-fusible Disconnects: (Heavy-duty) switches of classes and current ratings as indicated.

E. Double-Throw Switches: (Heavy-duty) switches of classes and current ratings as indicated.

F. Bolted Pressure Switches: Bolted pressure switches conforming to and listed under UL Standard 977, single- or double-throw arrangement as indicated. For fusible units, provide fuses as indicated.

G. Service Switches: (Heavy-duty) fusible/circuit breaker switches. UL listed for use as service equipment under UL Standard 98 or 869.

H. Switches for Classified (Hazardous) Locations: Heavy-duty switches with UL labels and listings for hazardous location classifications in which installed.

2.03 ACCESSORIES

A. Special Enclosure Material: Provide special enclosure material as follows for switches indicated:
   1. Stainless Steel for NEMA 12 and NEMA 4 switches.
   2. Molded fiberglass-reinforced plastic for NEMA 4X switches.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16420 - MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Types of motor controllers, including:

1. Combination controllers.
2. Solid-state reduced voltage controllers.
3. Fractional HP manual controllers.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Shop Drawings: Submit Shop Drawings of motor controllers showing dimensions and sizes.
   2. Product Data: Submit manufacturer's data and installation instructions on motor controllers.
   3. Wiring Diagrams: Submit power and control wiring diagrams for motor controllers

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. UL Compliance: Comply with applicable requirements of UL 486A and B, and UL 508, pertaining to installation of motor controllers. Provide controllers and components which are UL listed and labeled.
   2. NEMA Compliance: Comply with applicable requirements of NEMA Standards ICS 2, "Industrial Control Devices, Controllers and Assemblies," and Pub No. 250, "Enclosures for Electrical Equipment (1,000 Volts Maximum)," pertaining to motor controllers and enclosures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include (no or equal):
   1. Allen-Bradley Co.
   2. Square D Company.
   3. Eaton

2.02 MOTOR CONTROLLERS

A. Except as otherwise indicated, provide motor controllers and ancillary components which comply with manufacturer's standard materials, design, and construction in accordance with published product information and as required for a complete installation.

B. Combination Controllers: Consist of controller and circuit breaker or fusible disconnect switch mounted in common enclosure of types, sizes, ratings, and NEMA sizes indicated. Equip starters

with block-type manual reset overload relays. Provide control and pilot devices indicated. Provide 90 degree C SIS or MTW, No. 14 AWG control wiring, tagged at each termination. Provide operating handle for disconnect switch mechanism with indication and control of switch position, with enclosure door either opened or closed, and capable of being locked in OFF position with 3 padlocks. Construct and mount controllers and disconnect switches in single NEMA-type enclosure suitable for the location in which it is installed; coat with manufacturer's standard color finish.

1. The 3-phase starter may be the following types:
    a. Full Voltage Non-reversing (FVNR): One 3-pole magnetic contactor with a set of 3 overload devices.
    b. Full Voltage Reversing (FVR): Two 3-pole magnetic contactors with a common set of 3 overload devices.
    c. Two-speed (for two winding motor): Two, 3-pole magnetic contactors, each with its own set of 3 overload devices.
    d. Two-speed (for single winding motor): Two magnetic contactors, a 5-pole for high speed, and a 3-pole for low speed, each with its own set of 3 overload devices.
    e. Reduced Voltage (for wye-connected part winding motors): Two 3-pole magnetic contactors, each with its own set of 3 overload devices and a timer for closing of the running contactor. Running contactor shall be sized for motor full load current, and starting (half-winding) contactor shall be sized for at least 75 percent of the full load current and shall be capable of interrupting at least 10 times full load current.
    f. Reduced Voltage (closed transition autotransformer type): Three magnetic contactors, two 2-pole and one 3-pole with a common set of 3 overloads, a timing relay and an autotransformer with taps at 50, 65, 80, and 100 percent, and an integral temperature switch or timing relay to protect transformer windings.

C. Solid-State Reduced Voltage Controllers: Provide 3-phase, solid-state, reduced voltage motor controllers of sizes and ratings indicated.
    1. The controller shall be microprocessor-based and shall provide as a minimum the following modes of operation.
        a. Soft start with selectable kick-start.
        b. Soft stop.
        c. Current limit.
        d. Full voltage.
    2. The controller shall be self-calibrating and shall automatically adjust itself for line voltage, frequency and current fluctuations. It shall have adjustable starting acceleration and stopping deceleration. Provide transient protection for all controllers furnished.

D. Control and Pilot Devices: Provide an individually fused control power transformer in each starter unit. Provide 2 fuses in the transformer primary circuit and 1 in transformer secondary circuit. Size transformers such that they can supply 100VA in excess of the unit requirements or provide 150VA rated transformer, whichever is greater. Provide 300 volt rated, oiltight type pilot lights, push buttons with extended guard and black color insert. Equip stop push buttons with half guard and red color insert. Provide 120/6 volt transformer type push-to-test pilot lights with lens color indicated. Provide machine tool type relays, each with 1 spare N.O. contact. Provide 6-digit elapsed time indicators with one-tenth hour increments. When timers are required, they shall be synchronous type.

E. Fractional HP Manual Controllers: Provide 3-phase and single-phase fractional horsepower manual motor controllers, of sizes and ratings indicated. Equip with manually operated quick-make, quick-break toggle mechanisms, and with one-piece melting alloy type thermal units. Controller shall become inoperative when thermal unit is removed. Provide controllers with double-break silver alloy

contacts, visible from both sides of controller, and switch capable of being padlocked-OFF. Enclose controller unit in NEMA-type enclosure suitable for the location in which it is installed; coat with manufacturer's standard color finish.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16421 - MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product Data: Submit manufacturer's technical product data on NEMA Class 2, Type B motor control centers (MCCs).
   2. Submit layout Drawings of MCCs showing accurately scaled basic equipment sections including, but not limited to, motor starters, controllers, device panels, and circuit breakers. Show spatial relationships of MCC components to proximate electrical equipment. Clearly differentiate on wiring diagrams those conductors which are factory installed and those which are field installed.
   3. Fuse and Overload Sizes: Submit a compiled list of motors, fuse sizes, overload sizes, and types for motors actually installed.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01600, operation and maintenance manuals for items included under this Section. Include data and parts list for each MCC and troubleshooting maintenance guide.

1.02 QUALITY ASSURANCE

A. Codes and Standards:
   1. NEMA Compliance: Comply with NEMA Standards Pub/No. ICS-2, pertaining to construction, testing, and installation of MCCs, and with applicable NEMA standards for circuit breakers and fuses.
   2. UL Compliance: Comply with applicable requirements of UL Standard 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors," and UL Standard 845, "Electric Motor Control Centers." Provide MCCs and ancillary equipment which are UL listed and labeled.
   3. IEEE Compliance: Comply with applicable requirements of IEEE Standard 241 pertaining to construction and installation of MCCs.
   4. ANSI Compliance: Comply with applicable requirements of ANSI as applicable to MCCs.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include (no or equal):
   1. Allen-Bradley Co.

2.02 MOTOR CONTROL CENTERS AND COMPONENTS

A. Provide MCCs and ancillary components of sizes, ratings, classes, types, and characteristics indicated, which comply with manufacturer's standard design, materials, components, and

construction in accordance with published product information and as required for complete installation and as specified herein.

B. MCCs: For operation on power source rating indicated, consisting of one or more vertical sections, each with groupings of control units containing motor starters, thermal overload units, disconnects, and including such other electrical equipment as controls, control transformers, metering panels, current transformers, and auxiliary devices as indicated. Provide MCC with NEMA Class 2, Type B wiring, wire units using 90°C SIS or MTW stranded copper wire; No. 14 AWG minimum. Tag all wires at each termination.

C. MCC Supporting Structures: Factory assembled, dead-front, MCC standard supporting structures with enclosed vertical sections, fastened together to form rigid freestanding assembly. Construct each section 90 inches high with 9-inch horizontal wireways at top and bottom, 20 inches wide, and with 20-inch section depth for front-of-board unit arrangement. Provide NEMA Type 1A enclosure. Provide gasketing on all enclosing sheet steel, wireways, and unit doors. Construct units with 4-5/8-inch wide, 8-inch deep, 90-inch high vertical wireway in each vertical structure on right side of unit, accessible through hinged doors, and with supports at proper intervals within for fastening wires/cables. Form supporting members of not less than 13 gauge hot-rolled steel. Construct structure doors with removable pin hinges and secure with quarter-turn indicating type fasteners. Provide front-accessible main lug compartment for connection of incoming cables in top or bottom as indicated. Provide removable lifting angle full length of MCC. Design lifting angle to support entire weight of MCC section. Design bottom channels to be removable; provide holes for bolting MCC units to floor.
   1. Provide shipping splits in MCC lineup to allow for shipment of maximum 60-inch-long units. Design MCCs so matching vertical sections of same current rating and manufacturer can be added later at either end of lineup without use of transition sections. Provide removable end and top plates to close off openings.

D. Bus System: Tin-plated aluminum or copper, braced to withstand faults of 65,000 rms symmetrical amperes minimum unless indicated otherwise. Provide main horizontal bus with rating shown, and vertical bus rating of 300 amperes minimum; and construct vertical bus bars with protective barriers to prevent accidental contact of personnel with bus. Vertical bus shall be full length.
   1. Provide 0.25-inch by 1-inch minimum copper ground bus running full width of MCC at bottom of lineup. Drill ground bus and furnish 1 lug per starter unit, minimum.

E. Starter Units: Draw-out type, magnetic motor starters with fusible switch or motor circuit protector type disconnects, auxiliary control devices, and NEMA size as indicated. Construct each starter unit with doors, unit support pans, saddles, and disconnect operators; enclose and isolate each unit from adjacent units. Design units so that faults will be contained within compartments. Equip with thermal and magnetic overload protection device for each motor circuit, unit-mounted pilot devices, timers, selector switches, indicating lights, and control relays. Provide 1 spare normally open auxiliary contact. Provide draw-out units with de-energized position where unit is still supported by structure, but no electrical connection is made. Provide method of locking unit in de-energized position. Design plug-in units of same NEMA size and branch feeder units of same trip rating, to be interchangeable with each other.
   1. Three-phase starter may be following types:
      a. Full Voltage Nonreversing (FVNR): One 3-pole magnetic contactor with a set of 3 overload devices.
      b. Full Voltage Reversing (FVR): Two 3-pole magnetic contactors with a common set of 3 overload devices.

F. Unit Plug-On: Provide plug-on connections for each electrical power phase. Design contact fingers to be floating and self-aligning; silver plate contacts for obtaining low-resistance connections.

G. Disconnect Operators: Provide external operator handles for switches and circuit breakers. Design handle with up-down motion and with down position indicating OFF. Construct handles which permit locking handle in OFF position with 3 padlocks.

H. Unit Doors: Securely mounted with rugged concealed-type hinges which allow doors to swing open minimum of 115 degrees for ease of unit maintenance and withdrawal. Fasten doors to structure so that they remain in place when unit is withdrawn.
   1. Closed door must cover unit space when unit has been temporarily removed. Provide interlock for each unit door with associated disconnect mechanism to prevent door from opening when unit is energized.

I. Control and Pilot Devices: Provide an individually fused control power transformer in each starter unit. Provide 2 fuses in transformer primary circuit and 1 in transformer secondary circuit. Size transformers such that they can supply 100VA in excess of unit requirements or provide 150VA rated transformer, whichever is greater.
   1. Provide synchronous type timers unless otherwise noted.
   2. Provide 300 volt-rated, oil-tight type pilot lights, push buttons, and selector switches. Equip Start push button with extended guard and black color insert. Equip Stop push buttons with half guard and red color insert.
   3. Provide 120/6 volt transformer type push button to test pilot lights with lens color indicated.
   4. Provide machine tool type relays, each with 1 spare N.O. contact.
   5. Provide 6-digit elapsed time indicators with 1/10 hour increments.

J. Fusible Switch: Quick-make quick-break, gang-operated switches with positive pressure fuse clips suitable for use with class of fuses required. Provide switches with continuous current rating indicated and with a 100,000 ampere interrupting capability at rated voltage.

K. Motor Circuit Protector: Adjustable trip magnetic-only instantaneous molded-case circuit breakers for use in starter units. Provide a continuous current rating of at least 125 percent of the motor full load current and an interrupting capacity of 65,000 amps symmetrical. Provide a field adjustable instantaneous trip unit capable of being adjusted from 7 to 13 times motor full load current.

L. Circuit Breakers: Factory assembled, molded-case circuit breakers with permanent instantaneous magnetic and thermal trips in each pole 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 indication. Provide push-to-trip feature for testing and exercising circuit breaker trip mechanism. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees. Provide with AL/CU rated mechanical screw type removable connector lugs.

M. Finishes: Thoroughly clean interior and exterior prior to coating of MCC, including bolted joints, with rust-inhibiting prime coat. Provide 2 finish coats of manufacturer's standard color baked-on enamel finish.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16440 - PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:
   1. Lighting panelboards.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Manufacturer's product data on panelboards and enclosures.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. 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.
   2. NEMA Compliance: Comply with NEMA Standards Pub/No. 250, "Enclosures for Electrical Equipment (1,000 Volts Maximum)," Pub/No. PB 1, "Panelboards," and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."
   3. Federal Specification Compliance: Comply with FS W-P-115, "Power Distribution Panel," pertaining to panelboards and accessories.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. General Electric
   2. Eaton.
   3. Square D Company.

2.02 PANELBOARDS

A. Except as otherwise indicated, provide panelboards, enclosures, and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with 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.

B. Lighting Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, and types shown; with anti-turn 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 circuit breakers, and toggle handles that indicate when tripped. Provide suitable 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. Panelboards and circuit breakers shall be braced for 10,000 rms symmetrical amperes fault current unless otherwise indicated.

C. 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 or surface mounting as indicated. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

D. 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 degrees C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

E. Ground Fault Protected Breakers: Provide UL Class A protected GFI breakers with 6 mA for personnel protection, and for general-purpose receptacles. For breakers dedicated to equipment (sump pumps, heat trace, etc.), provide breaker with 30 mA equipment protection.

F. Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, ground-fault protection units or circuit breaker locking hardware as indicated.

G. Spares: In each panelboard provide 8 installed, single pole, 20A spare circuit breakers unless otherwise indicated.

PART 3 - EXECUTION

3.01 INSTALLATION OF PANELBOARDS

A. Type out panelboard's circuit directory card upon completion of installation Work.

END OF SECTION

SECTION 16497 - FUSES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Types of fuses specified, including:
   1. Class L time-delay.
   2. Class RK1 time-delay.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Product Data: Submit manufacturer's technical product data on fuses, including specifications, electrical characteristics, installation instructions, furnished specialties, and accessories. In addition, include voltages and current ratings, interrupting ratings, current limitation ratings, time-current trip characteristics curves, and mounting requirements.

1.03 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:
   1. UL Compliance and Labeling: Comply with applicable provisions of UL 198D, "High-Interrupting Capacity Class K Fuses." Provide overcurrent protective devices which are UL listed and labeled.
   2. ANSI Compliance: Comply with applicable requirements of ANSI C97.1, "Low-Voltage Cartridge Fuses 600 Volts or Less."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering fusable devices which may be incorporated in Work include:
   1. Bussmann Division, Cooper Industries.
   2. Commercial Enclosed Fuse Co.
   3. Littelfuse, Inc.
   4. Shawmut Division, Gould, Inc.
   5. Reliance Fuse Division, Federal Pacific Electric Co.

2.02 FUSES

A. Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time-current and peak let-through current characteristics indicated, which comply with manufacturer's standard

design, materials, and constructed in accordance with published product information, and with industry standards and configurations.

B. Class L Time-Delay Fuses: UL Class L time-delay fuses rated 600 volts, 60 Hertz, 800 amperes, with 200,000 rms symmetrical interrupting current rating for protecting transformers, motors, circuit breakers.

C. Class RK1 Time-Delay Fuses: UL Class RK1 dual element time-delay fuses rated 600 volts, 60 Hertz, 400 amperes, with 200,000 rms symmetrical interrupting current rating for protecting motors and circuit breakers.

2.03 EXTRA MATERIAL

A. Spare Fuses: For the types and ratings required, furnish additional fuses, amounting to 1 unit for every 10 installed units, but not less than 1 set of 3 of each kind.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.

C. NEMA MG 00001 - Motors and Generators; 2024.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 20 horsepower.

D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

E. Operation Data: Include instructions for safe operating procedures.

F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

B. Comply with NFPA 70.

C. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of high efficiency motors.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Baldor Electric Company/ABB Group: www.baldor.com/#sle.

B. Leeson Electric Corporation: www.leeson.com/#sle.

C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com/#sle.

D. Substitutions: Accepted Substitution.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service:

1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.

2. Motors Larger than 1/2 Horsepower: 480 volts, three phase, 60 Hz.

3. Test Change

B. Nominal Efficiency:

1. Open Motor with Two Poles: 82.5.

2. Open Motor with Four Poles: 82.5.

3. Open Motor with Six Poles: 50.0.

4. Enclosed Motor with Two Poles: 75.5.

5. Enclosed Motor with Four Poles: 82.5.

6. Enclosed Motor with Six Poles: 50.0.

C. Construction:

1. Open drip-proof type except where specifically noted otherwise.

2. Design for continuous operation in 104 degrees F environment.

3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.

4. Motors with frame sizes 254T and larger: Energy efficient type.

D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

F. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.

2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.

B. Single phase motors for shaft mounted fans, oil burners, and centrifugal pumps: Split phase type.

C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.

D. Single phase motors for fans, pumps, blowers, and air compressors: Capacitor start type.

E. Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.

F. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

G. Motors located in outdoors, in wet air streams downstream of sprayed coil dehumidifiers, in draw through cooling towers, and in humidifiers: Totally enclosed weatherproof epoxy-treated type.

H. Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.07 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Comply with NEMA MG 00001 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

I. Sound Power Levels: To NEMA MG 00001.

J. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

K. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

L. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

M. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 230513

SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Adhesive-backed duct markers.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.

2. Brimar Industries, Inc: www.pipemarker.com/#sle.

3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

5. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.

6. Substitutions: Accepted Substitution.

B. Letter Color: White.

C. Letter Height: 1/4 inch.

D. Background Color: Black.

E. Plastic: Comply with ASTM D709.

2.02 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.

2. Brady Corporation: www.bradycorp.com/#sle.

3. Brimar Industries, Inc: www.pipemarker.com/#sle.

4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

6. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

7. Substitutions: Accepted Substitution.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.03 ADHESIVE-BACKED DUCT MARKERS

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.

2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

4. Substitutions: Accepted Substitution.

B. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Use tags on piping 3/4 inch diameter and smaller.

1. Identify service, flow direction, and pressure.

2. Install in clear view and align with axis of piping.

3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION 230553

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic, steam, and refrigerating systems.

C. Field quality-control testing of Laboratory fume hoods.

D. Measurement of final operating condition of HVAC systems.

E. Sound measurement of equipment operating conditions.

F. Vibration measurement of equipment operating conditions.

G. Commissioning activities.

1.02 RELATED REQUIREMENTS

A. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

B. Section 230800 - Commissioning of HVAC.

1.03 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to Architect.

2. Include at least the following in the plan:

a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.

d. Final test report forms to be used.

e. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.

2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.

4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

5. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC (NSTSB), AABC National Standards for Total System Balance.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

2. Having minimum of three years documented experience.

3.02 AIR SYSTEM PROCEDURE

3.03 WATER SYSTEM PROCEDURE

3.04 COMMISSIONING

A. See Sections 019113 - General Commissioning Requirements and 230800 for additional requirements.

B. Perform prerequisites prior to starting commissioning activities.

C. Fill out Prefunctional Checklists for:

1. Air side systems.

2. Water side systems.

D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

E. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for ___ percent of the air handlers plus a random sample equivalent to ____ percent of the final TAB report data as directed by Commissioning Authority.

1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.

2. Use the same test instruments as used in the original TAB work.

3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.

4. For purposes of re-check, failure is defined as follows:

a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.

b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.

c. Temperatures: Deviation of more than one degree F.

d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.

e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.

5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.

F. In the presence of the Commissioning Authority, verify that:

1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.

2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.

3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

END OF SECTION 230593

SECTION 230713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

A. Section 230553 - Identification for HVAC Piping and Equipment.

1.03 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.

D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

F. ASTM C1104/C1104M - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation; 2019.

G. ASTM D4216 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly(Vinyl Chloride) (CPVC) Building Products Compounds; 2022.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. CertainTeed Corporation: www.certainteed.com/#sle.

2. Johns Manville: www.jm.com/#sle.

3. JP Lamborn Co: www.jpflex.com/#sle.

4. Knauf Insulation: www.knaufinsulation.com/#sle.

5. Manson Insulation, a company of Knauf Insulation: www.imanson.com/#sle.

6. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

7. Substitutions: Accepted Substitution See Section 016000 - Product Requirements.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.

2. Maximum Service Temperature: 1,200 degrees F.

3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.

2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

E. Indoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

2.03 GLASS FIBER, RIGID

A. Manufacturer:

1. CertainTeed Corporation: www.certainteed.com/#sle.

2. Johns Manville: www.jm.com/#sle.

3. Knauf Insulation: www.knaufinsulation.com/#sle.

4. Manson Insulation, a company of Knauf Insulation: www.imanson.com/#sle.

5. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

6. Substitutions: Accepted Substitution.

B. Insulation: ASTM C612; rigid, noncombustible blanket.

1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.

2. Maximum Service Temperature: 450 degrees F.

3. Maximum Water Vapor Absorption: 5.0 percent.

4. Maximum Density: 8.0 pcf.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.

2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

2.04 MINERAL WOOL, RIGID

A. Manufacturer:

1. CertainTeed Corporation: www.certainteed.com/#sle.

2. Johns Manville: www.jm.com/#sle.

3. Knauf Insulation: www.knaufinsulation.com/#sle.

4. Manson Insulation, a company of Knauf Insulation: www.imanson.com/#sle.

5. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

6. Substitutions: Accepted Substitution.

B. Insulation: ASTM C612; rigid, non-combustible, water repellant board

1. K Value: 0.24 at 75 degrees F when tested in accordance with ASTM C518.

2. Maximum Service Temperature: 450 degrees F.

3. Maximum Water Vapor Absorption: <1% by weight, <0.2% by volume when tested according to ASTM C1104/C1104M.

4. Maximum Density: 8.0 pcf.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:

1. Aeroflex USA: www.aeroflexusa.com/#sle.

2. Armacell LLC: www.armacell.us/#sle.

3. K-Flex USA LLC: www.kflexusa.com/#sle.

4. Substitutions: Accepted Substitution.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.

1. Minimum Service Temperature: Minus 40 degrees F.

2. Maximum Service Temperature: 180 degrees F.

3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

2.06 JACKETING AND ACCESSORIES

A. PVC Jacket:

1. For use on insulated ductwork installed in high traffice areas.

2. Comply with ASTM D4216 for polyvinyl chloride (PVC) sheet.

3. Thickness: 0.030 inch sheet.

4. Color: white.

5. Joining: Longitudinal slip joints and2 inch laps.

6. Metal Jacket Bands: 1/2 inch wide; 0.010 inch thick stainless steel.

B. Aluminum Jacket:

1. For use on insulated ductwork installed outdoors.

2. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.

3. Thickness: 0.016 inch sheet.

4. Finish: Embossed.

5. Joining: Longitudinal slip joints and 2 inch laps.

6. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.

7. Metal Jacket Bands: wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Ducts:

1. Provide insulation with vapor barrier jackets.

2. Finish with tape and vapor barrier jacket.

3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated Ducts Conveying Air Above Ambient Temperature:

E. Slope exterior ductwork to shed water.

F. External Duct Insulation Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.

2. Secure insulation without vapor barrier with staples, tape, or wires.

3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.

4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.

5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

END OF SECTION 230713

SECTION 230913
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control panels.

B. Dampers.

C. Damper Operators:

1. Electric operators.

D. Wall-, Surface-, and Duct-Mounted Sensors:

1. Damper position indicators.

2. Methane sensors.

3. Hydrogen sulphide sensors.

E. Thermostats:

1. Electric thermostats.

2. Room-mount thermostat accessories.

F. Fan and pump motor run-status monitoring.

1.02 RELATED REQUIREMENTS

A. Section 253513 - Integrated Automation Actuators and Operators.

B. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

C. Section 262726 - Wiring Devices: Elevation of exposed components.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2025).

B. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).

C. LonMark Interoperability Guide - LonMark Application-Layer Interoperability Guide and LonMark Layer 1-6 Interoperability Guide; Version 3.4; 2005.

D. Modbus (PS) - The Modbus Organization Communications Protocol.; Latest Update.

E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

F. NEMA BS 31032 - Residential Controls–Electrical Wall-Mounted Room Thermostats; 2025.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

D. Manufacturer's Instructions: Provide for all manufactured components.

E. Designer's qualification statement.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

I. Project Record Documents: Record actual location of control components, including panels, thermostats, and sensors.

J. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum _____ years experience approved by manufacturer.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a five year period after Substantial Completion.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

B. All devices and instruments shall be BACNet Testing Laboratories (BTL) listed unless noted otherwise. Proprietary controls are only allowed for controls internal to equipment.

2.02 CONTROL PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

B. Construction:

1. Comply with NEMA 250, Type 3 (outdoor and industrial use).

2. Material: 316 stainless steel.

C. Covers:

1. Continuous hinge.

2. Flush latch operable by screwdriver.

2.03 DAMPERS

A. See Section 233300 for dampers and this section for actuators and operators.

2.04 DAMPER OPERATORS

A. General:

1. Provide actuators with torque capacity sized for minimum of 20 percent greater than maximum design stream velocity and hold tight seal against maximum system pressures.

2. Provide spring return for two position control and for fail safe operation.

3. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.

4. Provide one operator for maximum 36 sq ft damper section.

5. See Section 253513 for field-mount damper actuators and operators.

B. Electric Operators:

1. Manufacturers:

a. Belimo Aircontrols (USA), Inc: www.belimo.com/#sle.

b. Honeywell International, Inc: buildingcontrols.honeywell.com/#sle.

c. Johnson Controls International, PLC: www.johnsoncontrols.com/#sle.

d. Schneider Electric: www.schneider-electric.us/#sle.

e. Substitutions: Accepted Substitution.

2. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.

3. For electric operators installed within Wet Well provide explosion proof housing rated for Class 1, Division 1 environments.

2.05 WALL-, SURFACE-, AND DUCT-MOUNT SENSORS

A. Damper Position Indicators: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 to 100 percent damper travel.

B. Methane Sensors, Wall:

1. Manufacturers:

a. Armstrong Monitoring: www.armstrongmonitoring.com.

b. MSA: www.msasafety.com.

c. Substitutions: Accepted Substitution.

2. Transmitter:

a. Housing: Class 1, Div 1 ABCD Explosion Proof.

b. Connection for external, replaceable sensing element.

c. Air Temperature: Range of -4 -to 122 degrees F.

d. Relative Humidity: Range of 15 to 95 percent (noncondensing).

3. Sensor:

a. Type: Catalytic Pellistor, replaceable.

b. Sensing: Range of 0 to 100 percent LEL.

c. Calibration: Factory calibrated.

C. Hydrogen Sulphide Sensors, Wall:

1. Manufacturers:

a. Armstrong Monitoring: www.armstrongmonitoring.com.

b. MSA: www.msasafety.com.

c. Substitutions: Accepted Substitution.

2. Transmitter:

a. Housing: Class 1, Div 1 ABCD Explosion Proof.

b. Connection for external, replaceable sensing element.

c. Air Temperature: Range of -4 -to 122 degrees F.

d. Relative Humidity: Range of 15 to 95 percent (noncondensing).

3. Sensor:

a. Type: Electrochemical Cell, replaceable.

b. Sensing: Range of 0 to 100 ppm.

c. Calibration: Factory calibrated.

2.06 THERMOSTATS

A. Electric Thermostats:

1. Manufacturers:

a. Honeywell International, Inc: buildingcontrols.honeywell.com/#sle.

b. Johnson Controls International, PLC: www.johnsoncontrols.com/#sle.

c. Resideo Technologies, Inc: www.resideo.com/#sle.

d. Siemens Industry, Inc: www.siemens.com/#sle.

e. Substitutions: Accepted Substitution.

2. Type: NEMA BS 31032, 24 volts, with setback/setup temperature control.

3. Service: Cooling and heating.

4. Covers: Locking with set point adjustment, with thermometer.

B. Room-Mounted Thermostat Accessories:

1. Thermostat Covers: Brushed aluminum.

2. Insulating Bases: For thermostats located on exterior walls.

3. Thermostat Guards: Metal mounted on separate base.

4. Aspirating Boxes: Where indicated for thermostats requiring flush installation.

2.07 FAN AND PUMP MOTOR RUN-STATUS MONITORING

A. Current Switches:

1. Manufacturers:

a. Automation Components, Inc: www.workaci.com/#sle.

b. Functional Devices, Inc: www.functionaldevices.com/#sle.

c. Schneider Electric: www.schneider-electric.us/#sle.

d. Veris Industries; H3xx, Micro Split-Core Series: www.veris.com/#sle.

e. Substitutions: Accepted Substitution.

2. Mini Solid-Core: 2-State, On/Off digital output of motor status with adjustable trip point to detect belt loss or mechanical failure.

3. Maximum AC Current Monitoring Value: As indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Ensure installation of components is complementary to installation of similar components.

G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 42 inches above floor. Align with lighting switches and humidistats; see Section 262726.

C. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

D. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

E. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

F. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

END OF SECTION 230913

SECTION 233100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ducts.

B. Nonmetal ducts.

1.02 RELATED REQUIREMENTS

A. Section 230713 - Duct Insulation: External insulation and duct liner.

B. Section 233319 - Duct Silencers.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

F. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).

G. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).

H. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

I. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

K. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

M. SMACNA (FRP) - Thermoset FRP Duct Construction Manual; 2016.

N. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.

D. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meets or exceed specified requirements.

E. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).

F. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

G. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.

B. Provide metal duct unless otherwise indicated.

C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 233319.

D. Duct Fabrication Requirements:

1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.

2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.

3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.

4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.

7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.02 METAL DUCTS

A. Material Requirements:

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

2. Aluminum: ASTM B209/B209M, aluminum sheet, alloy 3003-H14.

3. Stainless Steel: ASTM A666, Type 304.

B. Metal Duct Coating Requirements:

1. Corrosion resistant Coating: Factory- or field-applied in accordance with manufacturer's instructions.

2. Specialty Coatings for Metal Ducts: Factory- or field-applied in accordance with manufacturer's instructions.

a. Application: Chemical resistance.

3. PVC Coating for Steel Duct: 4 mils polyvinyl chloride plastic on both sides.

C. Rectangular Metal Duct:

1. Rectangular Double Wall Insulated: Rectangular spiral lock seam duct with galvanized steel outer wall, galvanized steel inner wall; fitting with the solid inner wall.

a. Insulation:

1) Thickness: 1 inch.

2) Material: Fiberglass.

D. Round Metal Ducts:

1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.

2. Round Double Wall Insulated Duct: Round spiral lock seam duct with galvanized steel outer wall, galvanized steel inner wall; fitting with the solid inner wall.

a. Insulation:

1) Thickness: 1 inch.

2) Material: Fiberglass.

3. Round Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).

E. Round Spiral Duct:

1. Round spiral lock seam duct with galvanized steel outer wall.

F. Connectors, Fittings, Sealants, and Miscellaneous:

1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.

2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).

3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.

b. VOC Content: Not more than 250 g/L, excluding water.

c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.

d. For Use with Flexible Ducts: UL labeled.

4. Gasket Tape:

a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.

5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

6. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:

a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.

b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.

c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.

d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

f. Other Types: As required.

2.03 NON-METAL DUCTS

A. Thermoset Fiber Glass Reinforced Plastic (FRP) Ducts:

1. Glass fiber reinforced plastic with minimum wall thickness of 3/16 inch.

2. Resin specific to corrosive agent in airstream.

3. Protection: Apply weather resistant and ultraviolet protection coatings for segments exposed to direct sunlight.

4. Compliance: Provide ductwork, fittings, supports, hangers, and appurtenances in accordance with SMACNA (FRP).

5. Manufacturers:

a. FRP Solutions by Monoxivent: www.fiberglass-duct.com/#sle.

b. Substitutions: Accepted Sustitution.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install products following the manufacturer's instructions.

C. Comply with safety standards NFPA 90A and NFPA 90B.

D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Flexible Ducts: Connect to metal ducts with adhesive.

G. PVC Coated Metal Ductwork: Tape with PVC tape.

H. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

I. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.

J. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

K. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.

L. Use double nuts and lock washers on threaded rod supports.

M. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.

N. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

O. Duct Insulation: Provide duct insulation. See Section 230713.

END OF SECTION 233100

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass backdraft dampers.

B. Duct access doors.

C. Duct test holes.

D. Fiberglass control dampers.

1.02 RELATED REQUIREMENTS

A. Section 233100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

PART 2 PRODUCTS

2.01 FIBERGLASS BACKDRAFT DAMPERS

A. Manufacturers:

1. Ruskin Company: www.ruskin.com/#sle.

2. Substitutions: Accepted Substitution.

B. Fiberglass Material Construction: ASTM E84, flame retardant, vinyl ester based resin.

C. Counterbalanced assembly, 18 inches round, flanged. Fiberglass-made frame with single butterfly blade. Steel-fabricated axle with graphite-filled PTFE sleeve bearings located out of airstream, and metal paint finish.

D. Counterbalanced assembly, 18 by 18 inches in size, flanged. Fiberglass-made frame with multiple v-groove-shaped blades. Stainless steel axle with molded PTFE bearings located out of airstream, elastomeric blade seals, and standard exterior coating.

E. Identification Tag: Custom octagon type, stainless steel, engraved.

1. Information: Show cfm (L/sec) with fail setting and part number.

2. Fastened: Beaded chain, stainless steel.

F. Maximum Operating Pressure: 10 in-wc.

G. Maximum Temperature Service: 200 degrees F.

2.02 DUCT ACCESS DOORS

A. Manufacturers:

1. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.

2. Nailor Industries, Inc: www.nailor.com/#sle.

3. Ruskin Company: www.ruskin.com/#sle.

4. Substitutions: Accepted Substitution.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.03 DUCT TEST HOLES

A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.04 FIBERGLASS CONTROL DAMPERS

A. Manufacturers:

1. Ruskin Company: www.ruskin.com/#sle.

2. Substitutions: Accepted Substitution.

B. Fiberglass Material Construction: ASTM E84, flame retardant, vinyl ester based resin.

C. Round: Fiberglass frame, counterclockwise inlet-vane blades, and axle assembly with molded PTFE bearings, flanged, and control shaft extended 6 inches beyond frame. Finished with standard exterior coating.

D. Rectangular: Fiberglass frame, airfoil-shaped opposed blades and axle assembly with molded PTFE bearings, flanged and stainless steel control linkage out of the airstream. Finished with standard exterior coating.

E. Identification Tag: Custom octagon type, stainless steel, engraved.

1. Information: Show cfm (L/sec) with fail setting and part number.

2. Fastened: Beaded chain, stainless steel.

F. Maximum Operating Pressure: 10 in-wc.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 233100 for duct construction and pressure class.

B. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION 233300

SECTION 233423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof ventilators.

B. Roof intake fans.

C. Upblast roof exhausters.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

B. AMCA 99 - Standards Handbook; 2016.

C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).

E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

G. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.

B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

D. Fabrication: Comply with AMCA 99.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.02 UPBLAST ROOF EXHAUSTERS

A. Manufacturers:

1. Greenheck Fan Corporation: www.greenheck.com/#sle.

2. Loren Cook Company<>: www.lorencook.com/#sle..

3. Substitutions: Accepted Substitution.

B. Direct Drive Fan:

1. Fan Wheel:

a. Type: Non-overloading, backward inclined centrifugal.

b. Material: Aluminum, statically and dynamically balanced.

2. Housing:

a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.

b. Rigid internal support structure.

c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.

d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.

e. Provide breather tube for fresh air motor cooling and wiring.

C. Shafts and Bearings:

1. Fan Shaft:

a. Ground and polished steel with anti-corrosive coating.

b. First critical speed at least 25 percent over maximum cataloged operating speed.

2. Bearings:

a. Permanently sealed or pillow block type.

b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.

D. Drive Assembly:

1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.

2. Belts: Static free and oil resistant.

3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

4. Motor pulley adjustable for final system balancing.

5. Readily accessible for maintenance.

E. Disconnect Switches:

1. Factory mounted and wired.

2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor Clean, Dry Locations: Type 1.

b. Outdoor Locations: Type 3R.

3. Finish for Painted Steel Enclosures: Provide manufacturer's standard or factory-applied gray unless otherwise indicated.

4. Positive electrical shutoff.

5. Wired from fan motor to junction box installed within motor compartment.

F. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

G. Performance Ratings: As indicated on drawings.

2.03 UPBLAST ROOF EXHAUSTERS, CHEMICAL RESISTANT

A. Manufacturers:

1. Aerovent Fan Company, Inc.: www.aerovent.com/#sle.

2. Hartzell Air Movement: www.hartzellairmovement.com/#sle.

3. Substitutions: Accepted Substitution.

B. Direct Drive Fan:

1. Fan Wheel:

a. Type: Non-overloading, backward inclined centrifugal.

b. Material: Aluminum, statically and dynamically balanced.

2. Housing:

a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.

b. Rigid internal support structure.

c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.

d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.

e. Provide breather tube for fresh air motor cooling and wiring.

C. Shafts and Bearings:

1. Fan Shaft:

a. Ground and polished steel with anti-corrosive coating.

b. First critical speed at least 25 percent over maximum cataloged operating speed.

D. Drive Assembly:

1. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

2. Readily accessible for maintenance.

E. Disconnect Switches:

1. Factory mounted and wired.Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor Clean, Dry Locations: Type 1.

b. Outdoor Locations: Type 3R.

2. Finish for Painted Steel Enclosures: Provide manufacturer's standard or factory-applied gray unless otherwise indicated.

3. Positive electrical shutoff.

4. Wired from fan motor to junction box installed within motor compartment.

F. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

G. Performance Ratings: As indicated on drawings.

2.04 ROOF INTAKE FANS

A. Manufacturers:

1. Loren Cook Company<>: www.lorencook.com/#sle..

2. Substitutions: See Section 016000 - Product Requirements.

B. Fan Unit: Direct-driven forward curved fan, resiliently-mounted induction motor, heavy duty ball bearings, powder-coated steel weatherproof cabinet with side intake hood, and removable service panels.

C. Performance Ratings: As indicated on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

D. Provide sheaves required for final air balance.

END OF SECTION 233423

SECTION 233700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gravity ventilators.

1.02 RELATED REQUIREMENTS

A. Section 233300 - Air Duct Accessories: Volume dampers for inlets and outlets.

1.03 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.

B. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.

C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 GRAVITY VENTILATORS

A. Hood Intake and Relief Gravity Ventilator:

1. Manufacturers:

a. Greenheck Fan Corporation: www.greenheck.com/#sle.

b. Loren Cook Company: www.lorencook.com/#sle.

c. Substitutions: Accepted Substitution.

2. Type: Fabra hood rectanular penthouse for intake or relief applications. Hood shall be hinged or removable for cleaning and maintenance.

3. Details: Refer to schedule on Drawings.

B. Spun Aluminum Intake and Relief Gravity Ventilator:

1. Manufacturers:

a. Greenheck Fan Corporation: www.greenheck.com/#sle.

b. Loren Cook Company: www.lorencook.com/#sle.

c. Substitutions: Accepted Substitution.

2. Type: Round spun aluminum penthouse for intake or relief applications. Hood shall be hinged or removable for cleaning and maintenance.

3. Details: Refer to schedule on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

3.02 CLOSEOUT ACTIVITIES

A. Demonstrate operational system to Owner's representative.

B. Instruct Owner's representative to maintain system and use occupant controls or interfaces, as required.

3.03 PROTECTION

A. Protect installed products until completion of project.

B. Replace, repair, or touch-up damaged products before Substantial Completion.

END OF SECTION 233700

SECTION 238200
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electric convectors.

B. Duct-mounted coils.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:

1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.

2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.

E. Manufacturer's Instructions: Indicate installation instructions and recommendations.

F. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

H. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 ELECTRIC CONVECTORS

A. Manufacturers:

1. Heatrex: www.heatrex.com/#sle.

2. INDEECO (Industrial Engineering and Equipment Company): www.indeeco.com/#sle.

3. Ouellet: www.ouellet.com/#sle.

4. TPI Corporation: www.tpicorp.com/#sle.

5. Stelpro Design Inc: www.stelpro.com/#sle.

6. Substitutions: Accepted Substitution.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.

C. Assembly includes linear limit control and automatic reset thermal cutout, with provisions for mounting on wall, floor, or pedestals.

D. Style: Flat top air outlet and bottom front air inlet.

E. Heating Elements: Stainless steel elements with aluminum fins and free-floating for noise free operation.

F. Enclosure:

1. Minimum 20 gauge, 0.0359 inch thick back panel and 16 gauge, 0.0598 inch thick sheet steel, exposed front panel, end caps, corners, and joiner pieces.

2. All joints to snap together without fasteners.

3. Provide removable front panel or access door for servicing and maintenance.

G. Finish:

1. Factory applied, painted finish.

2. Color: As indicated on drawings.

H. Controls: As indicated on drawings.

I. Electrical Characteristics: As indicated on drawings.

2.02 DUCT-MOUNTED COILS

A. Electric Coils:

1. Manufacturers:

a. Brasch Manufacturing Company: www.braschmfg.com/#sle.

b. INDEECO: www.indeeco.com/#sle.

c. Stelpro Design, Inc: www.stelpro.com/#sle.

d. TPI Corporation: www.tpicorp.com/#sle.

e. Substitutions: Accepted Substitution.

2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.

3. Heater Coil Assembly:

a. Minimum 20 gauge, 0.0359 inch thick, galvanized or corrosion resistant steel cabinet.

b. Terminal control box with hinged access cover, heating elements, and controls.

c. Relay or Contactor Controlled Heating Section:

1) Open Coil: Nickel chromium heating element, stainless steel or nickel plated terminals supported in ceramic bracket bushings.

2) Finned Tubular: Construction to consist of steel or stainless steel fins, brazed or helically wound to copper plated, steel, or stainless steel tubular sheath containing nickel chromium or high quality resistance wire heat element.

3) Over-Temperature Protection: Provide thermal cutouts for primary and secondary over-temperature protection.

d. Duct End Connections:

1) Round: Constructed for duct insertion using matching standard duct sizes.

2) Custom: Constructed for duct insertion or duct flanges using custom duct sizes.

4. Heater Controls: As indicated on drawings.

5. Electrical Characteristics:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

C. Do not damage equipment or finishes.

D. Convectors:

1. Install where indicated.

2. Coordinate to ensure correct recess size for recessed convectors.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

3.04 CLEANING

A. After construction and painting is completed, clean exposed surfaces of units.

B. Vacuum clean coils and inside of units.

C. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

3.05 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals for closeout submittals.

B. See Section 017900 - Demonstration and Training for additional requirements.

3.06 PROTECTION

A. Provide finished cabinet units with protective covers during the balance of construction.

END OF SECTION 238200