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CONTRACT
DOCUMENTS

April 2024

CITY OF

Rochester

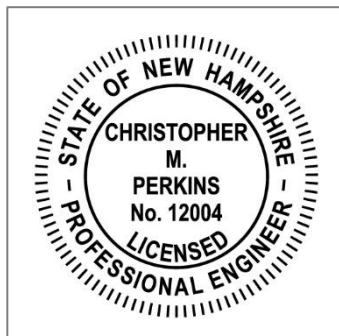
New Hampshire

Ledgeview Sewer Pump Station Upgrade

Clean Water State Revolving Fund (CWSRF)

Project Number: CS-334122-21

City of Rochester: Bid 24-39



April 24, 2024

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Section A: Bidding Documents

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Advertisement for Bids

Owner Name: City of Rochester, New Hampshire	Owner Project Number: 24-39		
Project Address:	54A Ledgeview Drive	Rochester	NH 03839
	Street # and name	City/Town	State ZIP

Separate sealed BIDS for the construction of: Ledgeview Sewer Pump Station Upgrade will be received by the City of Rochester, New Hampshire at the office of "Finance Office" 31 Wakefield Street Rochester, NH 03867 (**Reference Bid 24-39 on package**) until **5:00 PM**, Local Time on **Wednesday, May 29, 2024** and then opened at Council Chambers at City Hall at said address at **2:30 PM on Thursday, May 30, 2024** and publicly opened and read aloud.

City of Rochester, NH is soliciting a competitive bid;

1. **Bid: RFP 24-39 Ledgeview Sewer Pump Station**
2. **Bid Submission Options-Hardcopy, or Electronically:**
 - a) Submit Hardcopy via USPS, FEDEX, or UPS: City of Rochester, NH, Purchasing Agent 31 Wakefield St. Rochester, NH 03867. Reference **RFP 24-39** on package. In person drop offs are to go to the Finance Office at City Hall, 31 Wakefield Street, Rochester, NH 03867
 - b) Submit Electronically via Email: RFP24-39@rochesternhnet.onmicrosoft.com Include in Email subject line: **RFP 24-39**. An automated email confirmation will be generated to bidder once bid has been received. It is bidder's responsibility to ensure proper email submission of bid, and to monitor for the confirmation email.
3. **RFP Receipt Date & Time:** No later than **May 29th, 2024** at **5:00pm**.
4. **RFP Opening Date & Time:** **May 30th, 2024** at **2:30** Opening will be conducted in person in Council Chambers, 31 Wakefield Street, Rochester, NH 03867.
5. **RFP Specifications, Questions & Addendums (Q&A):** Can be obtained by visiting <https://rochesternh.gov/bids> see **OPEN BIDS** section. Or contact City of Rochester, NH Purchasing Agent 31 Wakefield St. Rochester, NH 03867, purchasing@rochesternh.gov, 603-335-7602. Note Q&A updates will end one week prior to bid opening.
6. **RFP Results:** Results can be obtained at <https://rochesternh.gov/bids>, in **CLOSED BIDS** section. Select the specific bid to see all results, or contact Purchasing Agent.

The project consists of the demolition of the existing Ledgeview Drive wastewater pumping station and generator; installation of building footing; installation of building; installation of suction-lift pumps, standby generator, station plumbing, and controls; repair and coating of existing wetwells; and reconnection to the existing forcemain.

1. Completion time for the project will be calculated as calendar days from the date specified in the "Notice to Proceed" as follows:
 - 270 calendar days for substantial completion.
 - 300 calendar days for final completionLiquidated damages will be in the amount of \$1,200, for each calendar day of delay from the date established for substantial completion, and \$1,200 for each calendar day of delay from the date established for final completion.
2. Each General Bid shall be accompanied by a Bid Security in the amount of 5% of the Total Bid Price.
3. The successful Bidder must furnish 100% Performance and Payment Bonds and will be required to execute the Contract Agreement within 10 days following notification of the acceptance of their Bid.
4. Any contract or contracts awarded under this Advertisement for Bids are expected to be funded in whole or in part by:
 - A loan from the NH Clean Water State Revolving Fund.
 - A grant from the American Rescue Plan Act from the NH Department of Environmental Services (ARPA).
5. The successful Bidder on this work is required to comply with the President's Executive Order No. 11246 entitled "Equal Employment Opportunity" as amended by Executive Order 11375, and amendments or supplements thereto, and as supplemented in Department of Labor Regulations (41 CFR Part 60). The requirements for bidders and contractors under this order are explained in the **Information For Bidders**.
6. Utilization of Minority and Women's Business Enterprises (MBEs and WBEs). The successful Bidder on this work must demonstrate compliance with the U.S. Environmental Protection Agency's MBE/WBE rule in order to be deemed a responsible bidder. The requirements for bidders and contractors covered by this rule are explained in the Information for Bidders.
7. The successful Bidder on this work is subject to U.S. Department of Labor's Davis Bacon wage provisions.
8. The successful bidder on this work is subject to the "**American Iron and Steel (AIS)**" requirements of the CWSRF and DWSRF programs.
9. No Bidder may withdraw a Bid within 75 days after the actual date of opening thereof.
10. A mandatory Pre-Bid Meeting will be held at the City of Rochester's Ledgeview Drive Sewer Pump Station, 54A Ledgeview Drive, Rochester, NH 03839 at 10:00 am on Monday, May 13, 2024. No other site visits will be made available without expressed written consent of the Engineer.

The Contract Documents may be examined at the following locations:

<https://rochesternh.gov/bids> or City of Rochester, NH Purchasing Agent 31 Wakefield St. Rochester, NH 03867, purchasing@rochesternh.gov, 603-335-7602

Information for Bidders All Contracts

Bids will be received by: City of Rochester herein called the "OWNER" at:
Address: 31 Wakefield Street Rochester NH 03867

Each Hardcopy BID must be submitted in a sealed envelope, addressed to:

City of Rochester, NH

Finance Office

Rochester, NH 03867

Reference Bid 24-39 on package.

Bid Submission Options-Hardcopy, or Electronically:

- a) Submit Hardcopy via USPS, FEDEX, or UPS: City of Rochester, NH, Purchasing Agent 31 Wakefield St. Rochester, NH 03867. Reference RFP 24-39 on package.

In person drop offs are to go to the Finance Office at City Hall, 31 Wakefield Street, Rochester, NH 03867

- b) Submit Electronically via Email: RFP24-39@rochesternhnet.onmicrosoft.com Include in Email subject line: RFP 24-39. An automated email confirmation will be generated to bidder once bid has been received. It is bidder's responsibility to ensure proper email submission of bid, and to monitor for the confirmation email.

Each sealed envelope containing a BID must be plainly marked on the outside as BID for Ledgeview Sewer Pump Station Upgrade and the envelope should bear on the outside the BIDDER's name, address and license number if applicable and the name of the project for which the BID is submitted. If forwarded by mail, the sealed envelope containing the BID must be enclosed in another envelope addressed to the OWNER at the Finance Office at 31 Wakefield Street, Rochester, NH 03867.

All BIDS must be made on the required BID form. All blank spaces for BID prices must be filled in, in ink or typewritten, and the BID form must be fully completed and executed when submitted. Only one copy of the BID form is required.

The OWNER may waive any informalities or minor defects or reject any and all BIDS. Any BID may be withdrawn prior to the above scheduled time for the opening of BIDS or authorized postponement thereof. Any BID received after the time and date specified shall not be considered. No BIDDER may withdraw a BID within 75 days after the actual date of the opening thereof. Should there be reasons why the contract cannot be awarded within the specified period, the time may be extended by mutual agreement between the OWNER and the BIDDER.

BIDDERS must satisfy themselves of the accuracy of the estimated quantities in the BID SCHEDULE by examination of the site and a review of the drawings and specifications including ADDENDA. After BIDS have been submitted, the BIDDER shall not assert that there was a misunderstanding concerning the quantities of WORK or of the nature of the WORK to be done.

The OWNER shall provide to BIDDERS prior to BIDDING, all information which is pertinent to, and delineates and describes, the land owned and rights-of-way acquired or to be acquired.

The CONTRACT DOCUMENTS contain the provisions required for the construction of the PROJECT. Information obtained from an officer, agent, or employee of the OWNER or any other person shall not affect the risks or obligations assumed by the CONTRACTOR or relieve them from fulfilling any of the conditions of the contract.

Each BID must be accompanied by a BID BOND payable to the OWNER in the amount of five percent (5%) of the total amount of the BID. As soon as the BID prices have been compared, the OWNER will return the BONDS of all except the three lowest responsive BIDDERS. When the AGREEMENT is executed, the bonds of the two remaining unsuccessful BIDDERS will be returned. The BID BOND of the successful BIDDER will be retained until the PAYMENT BOND and PERFORMANCE BOND have been executed and approved, after which it will be returned. A certified check may be used in lieu of a BID BOND.

A PERFORMANCE BOND and a PAYMENT BOND, each in the amount of 100 percent of the CONTRACT PRICE, with a corporate surety approved by the OWNER, will be required for the faithful performance of the contract.

Attorneys-in-fact who sign BID BONDS or PAYMENT BONDS and PERFORMANCE BONDS must file with each BOND a certified and effective dated copy of their power of attorney.

The party to whom the contract is awarded will be required to execute the AGREEMENT and obtain the PAYMENT BOND and PERFORMANCE BOND within ten (10) calendar days from the date when NOTICE OF AWARD is delivered to the BIDDER. The NOTICE OF AWARD shall be accompanied by the necessary AGREEMENT and BOND forms. In case of failure of the BIDDER to execute the AGREEMENT, the OWNER may at their option consider the BIDDER in default, in which case the BID BOND accompanying the proposal shall become the property of the OWNER.

The OWNER within ten (10) days of receipt of acceptable PAYMENT BOND, PERFORMANCE BOND and AGREEMENT signed by the party to whom the AGREEMENT was awarded shall sign the AGREEMENT and return to such party an executed duplicate of the AGREEMENT. Should the OWNER not execute the AGREEMENT within such period, the BIDDER may by WRITTEN NOTICE withdraw their signed AGREEMENT. Such notice of withdrawal shall be effective upon receipt of the notice by the OWNER.

The NOTICE TO PROCEED shall be issued within ten (10) days of the execution of the Agreement by the OWNER. Should there be reasons why the NOTICE TO PROCEED cannot be issued within such period, the time may be extended by mutual agreement between the OWNER and CONTRACTOR. If the NOTICE TO PROCEED has not been issued within the ten (10) day period or within the period mutually agreed upon, the CONTRACTOR may terminate the AGREEMENT without further liability on the part of either party.

The OWNER may make such investigations as Owner deems necessary to determine the ability of the BIDDER to perform the WORK, and the BIDDER shall furnish to the OWNER all such information and data for this purpose as the OWNER may request. The OWNER reserves the right to reject any BID if the evidence submitted by, or investigation of, such BIDDER fails to satisfy the OWNER that such BIDDER is properly qualified to carry out the obligations of the AGREEMENT and to complete the WORK contemplated therein.

A conditional or qualified BID will **not** be accepted.

Award will be made to the lowest responsive and responsible BIDDER.

All applicable laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the PROJECT shall apply to the contract throughout.

Each BIDDER is responsible for inspecting the site and for reading and being thoroughly familiar with the CONTRACT DOCUMENTS. The failure or omission of any BIDDER to complete any of the foregoing shall in no way relieve any BIDDER from any obligation in respect to their BID.

The low BIDDER shall supply the names and addresses of major material SUPPLIERS and SUBCONTRACTORS when requested to do so by the OWNER.

MANUFACTURER'S EXPERIENCE

Wherever it may be written that an equipment manufacturer must have a specified period of experience with their product, equipment which does not meet the specified experience period can be considered if the equipment supplier or manufacturer is willing to provide a bond or cash deposit for the duration of the specified time period which will guarantee replacement of that equipment in the event of failure.

PROJECT SIGN

The Contractor shall construct a sign in accordance with the Standard Detail included in these specifications. The sign shall be erected in a location selected by the Engineer or Owner in coordination with NHDES. The Contractor shall maintain the sign throughout the duration of the contract.

SAFETY AND HEALTH REGULATIONS

This project is subject to all the Safety and Health Regulations (CFR 29 Part 1926 and all subsequent amendments) as promulgated by the U.S. Department of Labor on June 24, 1974. Contractors shall comply with the requirements of these regulations.

NONDISCRIMINATION IN EMPLOYMENT

Contracts for work under this proposal will obligate the contractors and sub-contractors not to discriminate in employment practices.

STATE INSPECTION

Work performed on this project shall be subject to inspection by representatives of the New Hampshire Department of Environmental Services (NHDES). Such inspection shall in no sense make the State Government a party to this contract, unless said Government is also the Owner, and will in no way interfere with the rights of either party hereunder.

Representatives of NHDES shall be given Right of Access to all portions of the proposed work, including but not limited to actual work site, storage yards, offsite manufacturing and fabricating location and job records.

COPIES OF THE CONTRACT

There shall be at least five (5) executed copies of the Contract to be distributed as follows:

- a) One (1) copy each to the Owner, Engineer and Contractor.
- b) One electronic copy in PDF format to NHDES.
- c) Additional copies as required for other federal or state agencies contributing to or participating in project costs.

NON-RESIDENT CONTRACTORS

The successful bidder, if a corporation established under laws other than the State of New Hampshire, shall file, at the time of the execution of the contract, with the Owner, notice of the name of its resident attorney, appointed as required by the laws of the State of New Hampshire.

The successful bidder, if not a resident of New Hampshire, and not a corporation, shall file, at the time of execution of the contract, with the Owner a written appointment of a resident of the state of New Hampshire, having an office or place of business therein, to be their true and lawful attorney upon whom all lawful processes in any actions or proceedings against them may be served; and in such writing, which shall set forth said attorney's place of residence, shall agree that any lawful process against them which is served on said attorney shall be of the same legal force and validity as if served on them and that the authority shall continue in force so long as any liability remains outstanding against them in New Hampshire.

The power of attorney shall be filed in the office of the Secretary of State if required, and copies certified by the Secretary shall be sufficient evidence thereof. Such appointment shall continue in force until revoked by an instrument in writing, designating in a like manner some other person upon whom such processes may be served, which instrument shall be filed in the manner provided herein for the original appointment.

A Non-resident Contractor shall be deemed to be:

- a) A person who is not a resident of the State of New Hampshire.
- b) Any partnership that has no member thereof resident of the State of New Hampshire.
- c) Any corporation established under laws other than those of the State of New Hampshire.

BIDDERS' QUALIFICATIONS

No award will be made to any Bidder who cannot meet all of the following requirements:

- A. He shall not have defaulted nor turned the work over to the bonding company on any contract within three years prior to the bid date.
- B. He shall maintain a permanent place of business.
- C. He shall have adequate personnel and equipment to perform the work expeditiously.
- D. He shall have suitable financial status to meet obligations incidental to the work.
- E. He shall have appropriate technical experience satisfactory to the Engineer and the Division in the class of work involved.
- F. He shall be registered with the Secretary of State to do business in New Hampshire.
- G. He shall have performed to the satisfaction of the Engineer and the Division on previous contracts of a similar nature.
- H. He shall not have failed to complete previous contracts on time, including approved time extensions.

WITHDRAWAL OF BIDS

Prior to Bid Opening, bids may be withdrawn upon written or telegraphic request of the Bidder provided confirmation of any telegraphic withdrawal over the signature of the Bidder is placed in the mail and postmarked prior to the time set for Bid Opening. Bid documents and security of any Bidder withdrawing their bid in accordance with the foregoing conditions will be returned

AMERICAN IRON AND STEEL (AIS) PROVISIONS

The successful bidder on this work is subject to the "**American Iron and Steel (AIS)**" requirements of the CWSRF and DWSRF programs, which require the use of iron and steel products that are produced in the United States.

The **BIDDER'S AMERICAN IRON AND STEEL ACKNOWLEDGEMENT** shall be completed and signed by each Bidder and included with each bid. Additionally, CONTRACTOR shall certify and document to OWNER with each Application for Payment, and upon completion of the project that all iron and steel goods subject to this provision have been produced in the United States.

Bidders shall refer to [**PART D - FEDERAL PROVISIONS, RULES, REGULATIONS AND FORMS**](#) for additional information and guidance on AIS requirements.

DBE RULE PROGRAM REQUIREMENTS (MBEs and WBEs)

Bidders on this project are required to demonstrate compliance with the US Environmental Protection Agency's MBE/WBE rules in order to be deemed responsive. The MBE/WBE documentation, DBE Subcontractor Utilization Form and DBE Subcontractor Performance Forms (Formerly EPA Forms 6100-4 and 6100-3), shall be submitted with the bid.

The requirements for bidders and contractors are as follows:

State Revolving Fund loan recipients **and their contractors** must comply with the following DBE Rule requirements throughout the SRF loan project period:

- 1) Good Faith Efforts.
- 2) Annual Reporting of MBE/WBE accomplishments.
- 3) Contract Administration Requirements.
- 4) Bidders List Requirements.
- 5) Record Keeping.

Bidders shall refer to [**PART D - FEDERAL PROVISIONS, RULES, REGULATIONS AND FORMS**](#) for additional information on MBE/WBE requirements.

Further, the BIDDER agrees to abide by the requirements under Executive Order No. 11246, as amended, including specifically the provisions of the equal opportunity clause set forth in the GENERAL CONDITIONS.

Bidders shall, if requested, submit a compliance report concerning their employment practices and policies in order to maintain their eligibility to receive the award of contract.

Successful bidders shall, if requested, submit a list of all subcontractors who will perform work on the project, and written signed statements from authorized agents of labor pools with which they will or may deal for employees on the work together with supporting information to the effect that such labor pools' practices and policies are in conformity with Executive Order No. 11246; that they will affirmatively cooperate in or offer no hindrance to the recruitment, employment, and equal treatment of employees seeking employment and performing work under the contract or, a certification as to what efforts have been made to secure such statements when such agents or labor pools have failed or refused to furnish them prior to award of the contract.

Successful bidders must be prepared to comply in all respects with the contract provisions regarding non-discrimination.

DAVIS BACON WAGE RATES

This project is funded in whole or in part by a loan available through NHDES's Clean Water and/or Drinking Water SRF programs, and hence is subject to federal Davis Bacon wage provisions.

All laborers and mechanics employed by contractors or subcontractors on this project shall be paid wages at rates not less than those prevailing on projects of a character similar in the locality as determined by the U.S. Department of Labor (DOL) in accordance with Subchapter IV of Chapter 31 of Title 40, United States Code.

The **"Building"** General Wage Decision (GWD) for Strafford County, NH23, publication date 3/22/2024 applies to this project.

If the applicable wage determination does not provide a rate for a classification of work to be performed, **the contractor** must request additional classifications and wage rates to be added in conformance to the contract wage determination after contract award.

Guidance for USDOL conformance procedures is available using the following link:

<https://www.dol.gov/agencies/whd/government-contracts/construction/faq/conformance>

A copy of the applicable DOL wage determination is included in Attachment B in PART D- FEDERAL PROVISIONS, RULES, REGULATIONS AND FORMS in these project documents.

A copy of the applicable DOL wage determination(s) is included in the Supplementary Conditions.

Bidders shall refer to the above-referenced CWSRF Supplementary Conditions for additional information on guidance and Davis Bacon requirements.

SUSPENSION AND DEBARMENT

Bidders and contractors shall fully comply with Subpart C of 2 C.F.R. Part 180 entitled, "Responsibilities of Participants Regarding Transactions Doing Business With Other Persons," as implemented and supplemented by 2 C.F.R. Part 1532. subrecipient is responsible for ensuring that any lower tier covered transaction, as described in Subpart B of 2 C.F.R. Part 180, entitled "Covered Transactions," and 2 C.F.R. § 1532.220, includes a term or condition requiring compliance with 2 C.F.R. Part 180, Subpart C. Bidders and contractors are responsible for further requiring the inclusion of a similar term and condition in any subsequent lower tier covered transactions. Bidders and contractors acknowledge that failing to disclose the information required under 2 C.F.R. § 180.335 to NHDES may result in the delay or negation of this assistance agreement, or pursuance of administrative remedies, including suspension and debarment. Bidders and contractors may access the System for Award Management (SAM) exclusion list at "[System for Award Management \(SAM\)](#)" database to determine whether an entity or individual is presently excluded or disqualified.

By entering into this agreement, the Bidders and contractors certify that the Bidder and contractor is not debarred or suspended. Furthermore, the Bidder and contractors certify that no part of this contract will be subcontracted to a debarred or suspended person or firm.

Bidders shall refer to PART D – FEDERAL PROVISIONS, RULES, REGULATIONS AND FORMS for additional information on suspension and debarment requirements.

PROHIBITION ON CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT

This term and condition implements 2 CFR 200.216 and is effective for obligations and expenditures of EPA financial assistance funding on or after 8/13/2020. Bidders/contractors and their subcontractors must comply with the above provision when procuring or obtaining equipment, services, or systems that use covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

Bidders shall refer to [PART D - PROHIBITION ON CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT](#) for additional information on procuring or obtaining equipment, services, or systems using covered telecommunications equipment or services.

CIVIL RIGHTS COMPLIANCE

The sub-grantee, contractor, subcontractor, successor, transferee, and assignee shall comply, and shall include in every contract or agreement funded with these funds this same requirement to comply, with Title VI of the Civil Rights Act of 1964, which prohibits recipients of federal financial assistance from excluding from a program or activity, denying benefits of, or otherwise discriminating against a person on the basis of race, color, or national origin (42 U.S.C. § 2000d et seq.), as implemented by the Department of the Treasury's Title VI regulations, 31 CFR Part 22, which are herein incorporated by reference and made a part of this contract (or agreement). Title VI also includes protection to persons with "Limited English Proficiency" in any program or activity receiving federal financial assistance, 42 U.S.C. § 2000d et seq., as implemented by the Department of the Treasury's Title VI regulations, 31 CFR Part 22, and herein incorporated by reference and made a part of this contract or agreement.

Department of Labor (DOL) in accordance with Subchapter IV of Chapter 31 of Title 40, United States Code.

A copy of the applicable DOL wage determination(s) is included in Attachment B in [PART D- FEDERAL PROVISIONS, RULES, REGULATIONS AND FORMS](#) in these project documents.

If the applicable wage determination does not provide a rate for a classification of work to be performed, the Contractor must request additional classifications and wage rates to be added in conformance to the contract wage determination after contract award. You can find additional information on [DBA Conformances](#) in the US Department of Labor Learning Center.

DOMESTIC PREFERENCES FOR PROCUREMENTS (2 C.F.R. § 200.322)

As appropriate and to the extent consistent with law, to the greatest extent practicable, there is a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all subawards including all contracts and purchase orders for work or products under this award.

For purposes of this section:

- (1) "Produced in the United States" means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.
- (2) "Manufactured products" means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

RESTRICTIONS ON LOBBYING

The Contractor shall comply with the terms of 15 CFR part 28 and 2 CFR Part 200 Subpart E which prohibit the use of federal Contract funds to influence (or attempt to influence) a federal employee, and requires the submission of

Standard Form LLL ("Disclosure of Lobbying Activities") if *nonfederal* funds have been used to influence (or attempt to influence) a federal employee.

DRUG-FREE WORKPLACE

The Contractor shall comply with the terms of 2 CFR part 1329 which require that as a condition of the Agreement, certification that they maintain a drug-free workplace. By signing and submitting the Agreement, the Contractor certifies that they will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity associated with the Agreement.

PROTECTION FOR WHISTLEBLOWERS

The Contractor shall comply with the terms of 41 U.S.C. §471 regarding Whistleblower protections. As described in 41 USC §471 “an employee of a contractor, subcontractor, grantee, or subgrantee or personal services contractor may not be discharged, demoted, or otherwise discriminated against as a reprisal for disclosing to a person or body described in paragraph (2) information that the employee reasonably believes is evidence of gross mismanagement of a Federal contract or grant, a gross waste of Federal funds, an abuse of authority relating to a Federal contract or grant, a substantial and specific danger to public health or safety, or a violation of law, rule, or regulation related to a Federal contract (including the competition for or negotiation of a contract) or grant.”

CITY OF ROCHESTER INSTRUCTION TO BIDDERS

The Contractor shall review and comply with the City of Rochester, NH Instruction to Bidders found as an Attachment after Section D.

BID

Proposal of _____ (hereinafter called the "BIDDER", organized and existing under the laws of the State of ___ doing business as Corporation, Partnership, Individual to the City of Rochester, NH (herein after called "OWNER").

In compliance with your Advertisement for Bids, BIDDER hereby proposes to perform all WORK For the construction of Ledgeview Sewer Pump Station Upgrade RFP 24-39 in strict accordance with the CONTRACT DOCUMENTS, within the time set forth therein, and at the prices stated below.

By submission of this BID, each BIDDER certifies, and in the case of a joint BID each party thereto certifies as to their own organization, that this BID has been arrived at independently, without consultation, communication, or agreement as to any matter relating to the BID with any other BIDDER or with any competitor.

BIDDER hereby agrees to commence WORK under this contract on or before a date to be specified in the NOTICE TO PROCEED and to complete the PROJECT within:

- 270 calendar days for substantial completion.
- 300 calendar days for final completion

Liquidated damages will be in the amount of \$1,200 for each calendar day of delay from the date established for substantial completion and \$1,200 for each calendar day of delay from the date established for final completion, as provided in Section 18 of the General Conditions.

BIDDER acknowledges receipt of the following ADDENDUM:

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____

The Bidder shall state below what works of a similar character to that of the proposed contract they have performed and provide such references as will enable the Owner to judge their experience, skill, and business standing.

All questions must be answered, and the data given must be clear and comprehensive. This statement must be notarized. If necessary, add separate sheets.

Bidder Name:		
Permanent Main Office Address:		
Street # and name	City/Town	State ZIP
When was it organized?		Where incorporated?
<input type="checkbox"/> Yes	<input type="checkbox"/> No	Is the bidder registered with the Secretary of State to do business in NH?
For how many years has your firm engaged in the contracting business under its present name?		
Please list previous firm names and dates if applicable.		
Years	Previous Name	
Contracts on hand, attach a schedule or list showing gross amount of each contract and the approximate anticipated dates of completion.		
Describe the general character of work performed by your company.		
<input type="checkbox"/> Yes	<input type="checkbox"/> No	Have you ever failed to complete any work awarded you in the scheduled contract time, including approved time extensions? If so where and why?
<input type="checkbox"/> Yes	<input type="checkbox"/> No	Have you ever defaulted on a contract? If so where and why?
<input type="checkbox"/> Yes	<input type="checkbox"/> No	Have you ever had liquidated damages assessed on a contract? If so where and why?
List the more important contracts recently executed by your company:		
Recent Contract Name	Approximate Cost	Month/Year Completed
List your major equipment available for this contract: (Attach additional sheets as necessary.)		
List your key personnel available for this contract: (Attach additional sheets as necessary.)		
Staff Name	Role (i.e. Project Superintendent, Foreman)	

List any subcontractors whom you would expect to use for the following (unless this work is to be done by your own organization)		
Civil Engineering Utility Installation Other please describe:		
Please list banks with whom you conduct business.		
<input type="checkbox"/> Yes	<input type="checkbox"/> No	Do you grant the Engineer permission to contact this (these) institutions?
NOTE: Bidders may be required to furnish their latest financial statement as part of the award process.		
Respectfully Submitted:		
Signature: _____		Date: _____
Printed Name: _____		Title: _____
Street # and name		City/Town
State		ZIP
[Signed Name] Being duly sworn, deposes and says that they are [Position Title] of [Organization] and all the answers to the foregoing questions and all statement contained therein are true and correct.		
Sworn to before me this _____ day of _____, 20____		
_____, Notary Public		
My Commission Expires _____		
Seal		
Attest:		
BIDDER agrees to perform all the work described in the CONTRACT DOCUMENTS for the following unit prices or lump sum:		
NOTE: BIDS shall include sales tax and all other applicable taxes and fees.		

Bid Schedule

Item 1. LUMP SUM: Bidder agrees to perform all of the work described in the specifications and shown on the plans (except for the work included in Bid Item 2 below) for the sum of: _____ Dollars and _____ Cents(\$ _____)

Item 2. ALLOWANCE: Bidder agrees to include an allowance for the pump station instrumentation and controls equipment and technical services (scope of supply included in Section 01 22 00a) in the amount of: **Eighty One Thousand Dollars and Zero Cents (\$81,000.00)**

TOTAL BID: Bidder agrees to perform all of the work described in the specifications and shown on the plans for the sum of: _____ Dollars and _____ Cents(\$ _____)

(All entries shall be made clearly in ink or typewritten. Amounts are to be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.)

The above prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, engineering costs, etc., to cover the finished work of the several kinds called for.

The bidder understands that all bids for this project are subject to the applicable bidding laws of the State of New Hampshire.

The contract will be awarded to the lowest responsible and eligible bidder.

Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding.

The BIDDER hereby certifies, by checking the boxes below, that the following documents are included with this bid proposal:	
<input type="checkbox"/>	DBE Subcontractor Utilization Form NHDES Form #NHDES-W-09-059 (Formerly EPA Form 6100-4).
<input type="checkbox"/>	DBE Subcontractor Performance Forms NHDES-09-NHDES-W-09-058 (Formerly EPA Form 6100-3) Submit one form for each DBE subcontractor.
<input type="checkbox"/>	Bidder's American Iron and Steel acknowledgement.

All of these forms are in the SRF Federal Provisions: [Section D](#) of the front-end documents.

Bid Bond

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned as _____ Principal, and as _____ Surety, are hereby held and firmly bound unto the City of Rochester, NH as OWNER in the penal sum of _____ for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed, this _____ day of _____ in the year ____.

The condition of the above obligation is such that whereas the Principal has submitted to the City of Rochester, NH a certain BID, attached hereto and herby made a part hereof to enter into a contract in writing, for the Ledgeview Sewer Pump Station.

NOW, THEREFORE,

- (a) If said BID shall be rejected, or
- (b) If said BID shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (Properly completed in accordance with said BID) and shall furnish a BOND for faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise, the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by any extension of the time within which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

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

Principal Signature

Witnessed By:

Surety Signature

Witnessed By:

IMPORTANT-Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state of New Hampshire.

NHDES Front End Documents
Section B: Contract

Section B: Contract

Notice of Award	1
Acknowledgement of Notice	2
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NOTICE OF AWARD

Dated _____

TO: _____

ADDRESS: _____
Street Address City/Town State ZIP

Project Number	Owner Contract Number	RFP-24-39
Project : Ledgeview Sewer Pump Station Upgrade	Contract For: Ledgeview Sewer Pump Station Upgrade City of Rochester, NH	

You are notified that your bid dated _____ for the above contract has been considered. You are the apparent successful bidder and have been awarded a contract for:
Ledgeview Sewer Pump Station Upgrade

(Indicate total Work, alternates or sections of Work awarded)

The Contract Price of your contract is _____ dollars (\$_____).

Four (4) copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award. The same number of sets of the drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within 10 days of receiving this Notice of Award.

1. You must deliver to the OWNER all of the fully executed counterparts of the Agreement including all the Contract Documents. This includes the sets of drawings. Each of the Contract Documents must bear your signature on (the cover) (every) page.
2. You must deliver with the executed Agreement the Contract Security (Bonds) as specified in the Information for Bidders and General Conditions.
3. (List all other conditions of precedent.)

Failure to comply with these conditions within the time specified will entitle **OWNER** to consider your bid abandoned, to annul this Notice of Award and to declare your Bid Security forfeited.

Within 10 days after receipt of acceptable performance **BOND**, payment **BOND** and agreement signed by the party to whom the Agreement was awarded, the **OWNER** will return to you one fully signed counterpart of the Agreement with the Contract Documents attached.

(OWNER)

(Authorized Signature)

(Title)

ACKNOWLEDGEMENT OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged:

By: _____, The _____ day of _____, 20__ by
_____ title _____.

Copy to ENGINEER (Use Certified Mail, Return Receipt Requested)

AGREEMENT

THIS AGREEMENT, made this _____ day of _____, 20__ by and between the City of Rochester, New Hampshire, hereinafter called "**OWNER**" and _____ doing business as _____ (an individual, a partnership or a corporation) hereinafter called "**CONTRACTOR**".

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned:

1. The **CONTRACTOR** will commence and complete the construction of Ledgeview Sewer Pump Station Upgrade.
2. The **CONTRACTOR** will furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the **PROJECT** described herein.
3. The **CONTRACTOR** will commence the work required by the **CONTRACT DOCUMENTS** within _____ calendar days after the date of the **NOTICE TO PROCEED** unless the period for completion is extended otherwise by the **CONTRACT DOCUMENTS**. Completion time for the project will be calculated as calendar days from the date specified in the **NOTICE TO PROCEED** as follows:
 270 calendar days for substantial completion.
 300 calendar days for final completion.
 Liquidated damages will be in the amount of \$1,200 for each calendar day of delay from the date established for the substantial completion and \$1,200 for each calendar day of delay from the date established for final completion.
4. The **CONTRACTOR** agrees to perform all of the **WORK** described in the **CONTRACT DOCUMENTS** and comply with the terms therein for the sum of \$_____ or as shown in the **BID** schedule.
5. The term "**CONTRACT DOCUMENTS**" means and includes the following:
 - a. ADVERTISEMENT FOR BIDS
 - b. INFORMATION FOR BIDDERS
 - c. BID
 - d. BID BOND
 - e. NOTICE OF AWARD
 - f. AGREEMENT
 - g. PAYMENT BOND
 - h. PERFORMANCE BOND
 - i. CERTIFICATE OF INSURANCE
 - j. NOTICE TO PROCEED
 - k. CHANGE ORDER(S)
 - l. CERTIFICATON OF SUBSTANTIAL COMPLETION
 - m. CERTIFICATION OF FINAL COMPLETION
 - n. CONTRACTOR'S AFFIDAVIT
 - o. CONTRACTOR'S RELEASE
 - p. GENERAL CONDITIONS
 - q. SUPPLEMENTAL GENERAL CONDITIONS
 - r. SPECIAL CONDITIONS
 - s. FEDERAL PROVISIONS, RULES, REGULATIONS AND FORMS
 - t. DRAWINGS prepared by: _____ numbered _____ through _____ and dated _____, 20__

u. SPECIFICATIONS prepared or issued by:

_____ and dated
_____, 20__

v. ADDENDA

No. _____ dated _____, 20__

No. _____ dated _____, 20__

No. _____ dated _____, 20__

No. _____ dated _____, 20__

6. The **OWNER** will pay to the **CONTRACTOR** in the manner and at such times as set forth in the General Conditions such amounts as required by the **CONTRACT DOCUMENTS**.

7. This agreement shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors and assigns.

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials this Agreement in 6 copies, each of which shall be deemed an original on the date first above written.

OWNER: _____

By: _____

NAME: _____

(SEAL)

ATTEST: _____

NAME: _____

TITLE: _____

CONTRACTOR: _____

BY: _____

NAME: _____

ADDRESS: _____

(SEAL)

ATTEST: _____

NAME: _____

TITLE: _____

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that

_____, (contractor name),
_____, (contractor address), a
_____(corporation partnership, individual), hereinafter called
Principal, and _____, (surety name),
_____, (surety address) herein after called
surety, are held and firmly bound unto the City of Rochester, New Hampshire, (owner name), 209 Chestnut Hill Road,
Rochester, NH 03867, (owner address) hereinafter called OWNER and unto all persons, firms, and corporations who or
which may furnish labor, or who furnish materials to perform as described under the contract and to their successors
and assigns, in the total aggregate penal sum of _____dollars, (\$_____) in lawful
money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs,
executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the
OWNER, dated the _____ day of _____, 20___, a copy of which is hereto attached and made a part
hereof for the construction of Ledgeview Sewer Pump Station Upgrade.

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms, and corporations furnishing
materials for or performing labor in the prosecution of the **WORK** provided for in such contract, and any authorized
extension or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, coal and coke,
repairs on machinery, equipment and tools, consumed or used in connection with the construction of such **WORK**, and
for all labor cost incurred in such WORK including that be a subcontractor, and to any mechanic or materialman
lienholder whether it acquires its lien by operation of State or Federal Law; then this obligation shall be void; otherwise
to remain in full force and effect.

PROVIDED, that beneficiaries or claimants hereunder shall be limited to the subcontractors, and persons, firms, and
corporations having a direct contract with the PRINCIPAL or its SUBCONTRACTORS.

PROVIDED FURTHER, that the said Surety for value received hereby stipulates and agrees that no change, extension of
time, alteration or addition to the terms of the contract or to the **WORK** to be performed thereunder or the
SPECIFICATIONS accompanying the same shall in any way affect its obligation on this **BOND**, and it does hereby waive
notice of any such change, extension of time, alteration or addition to the terms of the contract or to the **WORK** or to
the **SPECIFICATIONS**.

PROVIDED, FURTHER that no suit or action shall be commenced hereunder by any claimant: (a) Unless claimant, other
than one having a direct contract with the PRINCIPAL shall have given written notice to any two of the following: The
PRINCIPAL, the OWNER, or the SURETY above named within ninety (90) days after such claimant did or performed the
last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial
accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work
or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail,
postage prepaid, in an envelope addressed to the PRINCIPAL, OWNER, or SURETY, at any place where an office is
regularly maintained for the transaction business, or served in any manner in which legal process may be served in the
state in which the aforesaid project is located, save that such service need not be made by a public officer; (b) After the
expiration of one (1) year following the date on which PRINCIPAL ceased work on said CONTRACT, it being understood,
however, that if any limitation embodied in the BOND is prohibited by any law controlling the construction hereof, such
limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

PROVIDED, FURTHER, that it is expressly agreed that this BOND shall be deemed amended automatically and immediately, without formal and separate amendments hereto, upon amendment to the Contract not increasing the contract price more than 20 percent, so as to bind the PRINCIPAL and the SURETY to the full and faithful performance of the Contract as so amended. The term "Amendment", wherever used in this BOND and whether referring to this BOND, the contract or the loan Documents shall include any alteration, addition, extension or modification of any character whatsoever.

PROVIDED FURTHER, that no final settlement between the **OWNER** and the **CONTRACTOR** shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____
counterparts, each one of which shall be deemed an original this day of _____, 20__

ATTEST:

BY: _____
(Principal) Secretary

BY: _____
Witness as to Principal

(ADDRESS)

ATTEST:

BY: _____
Witness to Surety

(PRINCIPAL)

BY: _____

(ADDRESS)

(SURETY)

BY: _____
(ATTORNEY in FACT)

(ADDRESS)

NOTE: Date of **BOND** must not be prior to date of Contract.
If **CONTRACTOR** is partnership, all partners should execute BOND.

IMPORTANT: Surety companies executing **BONDS** must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of New Hampshire.

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that

_____, (contractor name),
_____, (contractor address), a
_____(corporation partnership, individual), hereinafter called
Principal, and _____, (surety name),
_____, (surety address) herein after called
surety, are held and firmly bound unto the City of Rochester, New Hampshire, (owner name), 209 Chestnut Hill Road,
Rochester, NH 03867, (owner address) hereinafter called **OWNER** in the total aggregate penal sum of
_____dollars, (\$_____)in lawful money of the United States, for the payment of
which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns,
jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the
OWNER, dated the _____ day of _____, 20___, a copy of which is hereto attached and made a part
hereof for the construction of Ledgeview Sewer Pump Station Upgrade.

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants,
terms, conditions, and agreements of said contract during the original term thereof, and any extension thereof which
may be granted by the **OWNER**, with or without notice to the Surety and during the one year guaranty period, and if the
PRINCIPAL shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless
the **OWNER** from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay
the **OWNER** all outlay and expense which the **OWNER** may incur in making good any default, then this obligation shall
be void: otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said surety, for value received hereby stipulates and agrees that no change, extension of
time, alteration or addition to the terms of the contract or to **WORK** to be performed thereunder or the specifications
accompanying same shall in any way affect its obligation on this **BOND**, and it does hereby waive notice of any such
change, extension of time alteration or addition to the terms of the contract or to the **WORK** or to the specifications.

PROVIDED, FURTHER, that it is expressly agreed that this **BOND** shall be deemed amended automatically and
immediately, without formal and separate amendments hereto, upon amendment to the Contract not increasing the
contract price more than 20 percent, so as to bind the **PRINCIPAL** and the **SURETY** to the full and faithful performance of
the Contract as so amended. The term "Amendment", wherever used in this **BOND** and whether referring to this **BOND**,
the contract or the loan Documents shall include any alteration, addition, extension or modification of any character
whatsoever.

PROVIDED, FURTHER, that no final settlement between the **OWNER** and the **CONTRACTOR** shall abridge the right of any
beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in Six (6) counterparts, each one of which shall be deemed an original this day of _____, 20__

ATTEST:

BY: _____
(Principal) Secretary

BY: _____
Witness as to Principal

(ADDRESS)

ATTEST:

BY: _____
Witness to Surety

(PRINCIPAL)

BY: _____

(ADDRESS)

(SURETY)

BY: _____
(ATTORNEY in FACT)

(ADDRESS)

NOTE: Date of **BOND** must not be prior to date of Contract.
If **CONTRACTOR** is partnership, all partners should execute BOND.

IMPORTANT: Surety companies executing **BONDS** must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of New Hampshire.

NOTICE TO PROCEED

Dated _____, 20__

TO: _____
(Insert Name of Contractor as it appears in the Bid Documents)

ADDRESS: _____

OWNER'S PROJECT NO. 24-39

PROJECT: Ledgeview Sewer Pump Station Upgrade

OWNER'S CONTRACT NO. _____

CONTRACT FOR: Ledgeview Sewer Pump Station Upgrade

You are notified that the Contract Time under the above contract will commence to run on _____, 20__ . By that date, you are to start performing your obligations under the Contract Documents. In accordance with paragraph 3 of the Agreement, the dates of Substantial Completion and Final Completion are _____, 20__ and _____, 20__, respectively.

Before you may start any Work at the site, paragraph 27 of the General Conditions provides that you and Owner must each deliver to the other (with copies to ENGINEER) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents. Also before you may start any Work at the site, you must:

Copy to ENGINEER
(Use Certified Mail, return receipt Requested)

ACKNOWLEDGEMENT OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged by:

(Contractor)

This the _____, day of 20__, by _____

Employee Identification Number: _____

CHANGE ORDER

No. _____

PROJECT NAME:	Ledgeview Sewer Pump Station Upgrade	DATE OF ISSUANCE:		
OWNER:	City of Rochester, New Hampshire	OWNER PROJECT NO.	24-39	
OWNER ADDRESS:	209 Chestnut Hill Road	Rochester	NH	03867
	Street Name	City/Town	State	ZIP
CONTRACTOR:				
CONTRACT FOR:				
ENGINEER:	Weston & Sampson Engineers	ENG. PROJECT NO.	ENG23-0367	
ENGINEER ADDRESS:	100 International Drive, Suite 152	Portsmouth	NH	03801
	Street Name	City/Town	State	ZIP

You are directed to make the following changes in the Contract Documents.

Description: _____

Purpose of Change Order: _____

Justification: _____

Attachments: (List documents supporting change)

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIME
Original Contract Price	Original Contract Time days date
Previous Change Orders	Net change from previous Change Orders days date
Contract Price prior to this Change Order	Contract Time prior to this Change Order days date
Net Increase (Decrease) of this Change Order	Net Increase (decrease) this Change Order days date
Contract Price with all approved Change Orders	Contract Time with all Change Orders days date

This document will become a supplement to the CONTRACT and all provisions will apply hereto. The attached Contractor's Revised Project Schedule reflects increases or decreases in Contract Time as authorized by this Change Order.

Stipulated price and time adjustment includes all costs and time associated with the above described change. Contractor waives all rights for additional time extension for said change. Contractor and Owner agree that the price(s) and time adjustment(s) stated above are equitable and acceptable to both parties.

RECOMMENDED BY:	APPROVED BY:	APPROVED BY:	APPROVED BY:
Engineer	Owner	Contractor	NHDES
Date	Date	Date	Date

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner Project No. 24-39 Engineer Project No. ENG23-0367

Project: Ledgeview Sewer Pump Station Upgrade

Contractor: _____

Contract For: Ledgeview Sewer Pump Station Upgrade Contract Date: _____

This Certificate of Substantial Completion applies to all work under the Contract Documents or to the following specified parts thereof:

To City of Rochester
(Owner)

And to _____
(Contractor)

The Work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR and ENGINEER, and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on Documents on _____.
(Date of Substantial Completion)

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all the work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR within _____ calendar days of the above Substantial Completion.

The responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as follows:

RESPONSIBILITIES:

OWNER: City of Rochester, New Hampshire

CONTRACTOR: _____

The following documents are attached to and made a part of this Certificate:

This certificate does not constitute an acceptance of work not in accordance with the Contract Documents nor is it a release of CONTRACTOR's obligation to complete the work in accordance with the Contract Documents.

Executed by the Engineer on

_____, 20__

Weston & Sampson Engineers
(Engineer)

By: _____

CONTRACTOR accepts this Certificate of Substantial Completion on _____, 20__

(Contractor)

By: _____

OWNER accepts this Certificate of Substantial Completion on _____, 20__

City of Rochester, New Hampshire
(Owner)

By: _____

NHDES-W-09-015



CERTIFICATE OF FINAL COMPLETION
NHDES CLEAN WATER AND DRINKING WATER
STATE REVOLVING FUND



Owner Project No. 24-39 Engineer Project No. ENG23-0367
 Project: Ledgeview Sewer Pump Station Upgrade
 Owner: City of Rochester, New Hampshire
 Contractor: _____
 Engineer: Weston & Sampson Engineers
 Agreement Date: _____
 Notice to Proceed Date: _____
 Contractual Substantial Completion date as modified by change orders: _____
 Actual Substantial Completion date _____
 Contractual final completion date as modified by Change Orders _____

The work to which this certificate applies has been inspected by authorized representatives of Owner, Contractor, Engineer and NHDES, the punch list has been completed and the work of the contract is hereby declared to be Finally Complete in accordance with the Contract Documents on _____.
 (Date of Final Completion)

This certificate does not constitute an acceptance of any work not in accordance with the Contract Documents nor is it a release of contractor's obligation to complete the work in accordance with the Contract Documents. The warranty for all work completed subsequent to the date of Substantial Completion expires one year from the date of this Final Acceptance.

Executed by Engineer on _____, 20__

By: _____

Contractor Accepts this Certificate of Final Completion on _____, 20__

By: _____

Owner Accepts this Certificate of Final Completion on _____, 20__

By: _____

NHDES Accepts this Certificate of Final Completion on _____, 20__

By: _____

CONTRACTORS AFFIDAVIT

STATE OF: _____

COUNTY OF: _____

Before me the undersigned a _____ (Notary Public, Justice of the Peace, Alderman) in and for said County and State Personally appeared _____ (Individual, partner or duly who being duly sworn according to law deposes and says that the cost of all the Work, and outstanding claims and indebtedness of whatever nature arising out of the performance of the contract between City of Rochester, New Hampshire(Owner) and _____ (Contractor) of _____ (Contractor Address) dated _____ for the construction of the Ledgeview Sewer Pump Station Upgrade (Project Name) and necessary appurtenant installations have been paid in full.

(Individual, Partner, or duly authorized representative of corporate contractor)

(Title)

Sworn to and subscribed before me
this ____ day of _____, 20__

(Notary Public)

CONTRACTOR'S FINAL RELEASE AND WAIVER OF LIEN

Project Name: _____
 Project Address: _____
 Street Name City/Town State ZIP
 Owner Name: _____
 Contractor Name: _____
 Contractor Address: _____
 Street Name City/Town State ZIP

TO ALL WHOM IT MAY CONCERN:

For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned Contractor hereby waives, discharges, and releases any and all liens, claims, and rights to liens against the above-mentioned project, and any and all other property owned by or the title to which is in the name of the above-referenced Owner and against any and all funds of the Owner appropriated and available for the construction of said project, and any and all warrants drawn upon or issued against any such funds or monies, which the undersigned Contractor may have or may hereafter acquire or process as a result of the furnishing of labor, materials and/or equipment, and the performance of work by the Contractor on or in connection with said project, whether under and pursuant to the above-mentioned contract between the Contractor and the Owner pertaining to said project or otherwise, and which said liens, claims or rights of lien may arise and exist.

The undersigned further hereby acknowledges that the sum of:

_____ Dollars (\$ _____) constitutes the entire **unpaid** balance due the undersigned in connection with said project whether under said contract or otherwise and that the payment of said sum to the contractor will constitute payment in full and will fully satisfy any and all liens, claims, and demands which the contractor may have or assert against the owner in connection with said contract or project.

Dated this _____ day of _____ 20__

 (Contractor)

Witness to Signature

BY: _____
 Title

BY: _____
 Title

NHDES Front End Documents Section C: General Conditions

General Conditions

Section C: General Conditions

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General Conditions

1. Contract and Contract Documents.

The plans, information for bidders, bids, advertisement for bids, bid payment and performance bonds, agreements, change orders, notice to proceed, specifications and addenda, hereinafter enumerated in the agreement, shall form part of this Contract and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light on the interpretation of the provisions to which they refer.

2. Definitions.

- 2.1 "Addenda" means written or graphic instruments issued prior to the execution of the agreement which modify or interpret the Contract Documents, drawings and specifications, by additions, deletions, clarifications or corrections. Such written or graphic instruments will be issued no less than five days before the bid opening.
- 2.2 "Bid" means the offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the work to be performed.
- 2.3 "Bidder" means any person, firm or corporation submitting a bid for the work.
- 2.4 "Bonds" means bid, performance, and payment bonds and other instruments of security, furnished by the Contractor and his surety in accordance with the Contract Documents.
- 2.5 "Change Order" means a written order to the Contractor authorizing an addition, deletion or revision in the work within the general scope of the Contract Documents, or authorizing an adjustment in the Contract Price or Contract Time.
- 2.6 "Contract Documents" means the Contract, including any advertisement for bids, information for bidders, bid, bid bond, agreement, payment bond, performance bond, notice of award, notice to proceed, change orders, drawings, specifications and addenda.
- 2.7 "Contract Price" means the total monies payable to the Contractor under the terms and conditions of the Contract Documents.
- 2.8 "Contract Time" means the number of calendar days stated in the Contract Documents for the completion of the work.
- 2.9 "Contractor" means the person, firm or corporation with whom the owner has executed the agreement.
- 2.10 "Division" means the state of New Hampshire Department of Environmental Services, Water Division.
- 2.11 "Drawings" mean the part of the Contract Documents which show the characteristics and scope of the work to be performed and which have been prepared or approved by the engineer.
- 2.12 "Engineer" means the person, firm or corporation named as such in the Contract Documents.
- 2.13 "Field order" means a written order effecting a change in the work not relating to an adjustment in the Contract price or an extension of the Contract time and issued by the engineer to the Contractor during construction.
- 2.14 "Notice of Award" means the written notice of the acceptance of the bid from the owner to the successful Bidder.

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- 2.15 "Notice to Proceed" means the written communication issued by the owner to the Contractor authorizing him to proceed with the Work and establishing the date of commencement of the work.
- 2.16 "Owner" means a public or quasi-public body or authority, corporation, association, partnership, or individual for whom the work is to be performed.
- 2.17 "Plans" means the Contract drawings or exact reproductions thereof which show the scope, character, dimensions and details of the work and which have been prepared or approved by the engineer.
- 2.18 "Project" means the undertaking to be performed as provided in the Contract Documents.
- 2.19 "Resident Project Representative" means the authorized representative of the owner who is assigned to the project site or any part thereof.
- 2.20 "Shop Drawings" means all drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a subcontractor, manufacturer, supplier or distributor, which illustrates how specific portions of the work shall be fabricated or installed.
- 2.21 "Special conditions" means revisions or additions to these general conditions, supplemental general conditions or specifications applicable to an individual project.
- 2.22 "Specifications" means a part of the Contract Documents consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and workmanship.
- 2.23 "Subcontractor" means an individual, firm or corporation having a direct Contract with the Contractor or with any other Subcontractor for the performance of a part of the work at the site.
- 2.24 "Substantial Completion" means that date as certified by the engineer when the construction of the Project or a specified part thereof is sufficiently completed, in accordance with the Contract Documents, so that the project or specified part can be utilized for the purposes for which it is intended.
- 2.25 "Supplemental General Conditions" means modifications to these general conditions required by a federal agency for participation in the Project and approved by the agency in writing prior to inclusion in the Contract Documents, or such documents that may be imposed by applicable state laws.
- 2.26 "Supplier" means any person or organization who supplies materials or equipment for the work, including that fabricated to a special design, but who does not perform labor at the site.
- 2.27 "Work" means all labor necessary to produce the construction required by the Contract Documents, and all materials and equipment incorporated or to be incorporated in the project.
- 2.28 "Written Notice" means any notice to any party of the agreement relative to any part of this agreement in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party at his last given address, or delivered in person to said party or his authorized representative on the work.

3. Additional Instructions and Detail Drawings.

The Contractor may be furnished additional instructions and detail drawings as necessary to carry out the work included in the Contract. The additional drawings and instructions thus supplied to the Contractor will coordinate with the Contract Documents and will be so prepared that they can be reasonably interpreted as part thereof.

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- 4. Shop or Setting Drawings.** Shop or setting drawings shall be in accordance with the following:
- 4.1 The Contractor shall furnish 6 copies of the manufacturer's shop drawings, specific design data as required in the detailed specifications, and technical literature covering all equipment and fabricated materials which he proposes to furnish under this Contract in sufficient detail to indicate full compliance with the specifications. Shop drawings shall indicate the method of installing, the exact layout dimensions of the equipment or materials, including the location, size and details of valves, pipe connections, etc.
 - 4.2 No equipment or materials shall be shipped until the manufacturer's shop drawings and specifications or other identifying data, assuring compliance with these specifications, are approved by the engineer.
 - 4.3 The Contractor shall check and verify all field measurements and shall be responsible for the prompt submission of all shop and working drawings so that there shall be no delay in the work.
 - 4.4 Regardless of corrections made in or approval given to such drawings by the engineer, the Contractor will nevertheless be responsible for the accuracy of such drawings and for their conformity to the plans and specifications. The Contractor shall notify the engineer in writing of any deviations at the time he furnishes such drawings. He shall remain responsible for the accuracy of the drawings showing the deviations but not for the acceptance of the deviations from the original design shown in the plans and specification. Approval by the engineer and the owner of any deviation in material, workmanship or equipment proposed subsequent to approval of the shop drawings or design data, shall be requested in writing by the Contractor.
 - 4.5 When submitted for the engineer's review, shop drawings shall bear the Contractor's certification that he has reviewed, checked and approved the shop drawings and that they are in conformance with the requirements of the Contract Documents.
- 5. Materials, Services, Facilities and Workmanship** shall be furnished as follows:
- 5.1 Except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature, and all other services and facilities of every nature whatsoever necessary to execute, complete, and deliver the work within the specified time.
 - 5.2 Unless otherwise specifically provided for in the specifications, all workmanship, equipment, materials and articles incorporated in the work shall be new and the best grade of the respective kinds for the purpose.
 - 5.3 The Contractor shall furnish to the engineer for approval the manufacturer's detailed specifications for all machinery, mechanical and other special equipment, which he contemplates installing together with full information as to type, performance characteristics, and all other pertinent information as required.
 - 5.4 Materials which are specified by reference to the number or symbol of a specific standard, such as an ASTM standard, a federal specification or other similar standard, shall comply with requirements in the latest revision thereof and any amendment or supplement thereto in effect on the date of the advertisement for bids, except as limited to type, class or grade, or modified in such reference. The standards referred to shall have full force and effect as though printed therein.
 - 5.5 For equipment or for materials, when requested by the engineer, the Contractor shall submit certificates of compliance from the manufacturer, certifying that the equipment or the materials comply with the requirements of the specifications or the standards.

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5.6 Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

5.7 Materials, supplies, and equipment shall be in accordance with samples submitted by the Contractor and approved by the engineer.

6. Contractor's Title To Materials.

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

7. Inspection and Testing of Materials shall be as follows:

7.1 All materials and equipment used in the construction of the project shall be subject to inspection and testing by the engineer in accordance with accepted standards at any and all times during manufacture or during the project construction and at any or all places where such manufacture is carried on.

7.2 The Contractor shall furnish promptly upon request by the engineer, all materials required to be tested. All tests made by the engineer shall be performed in such manner and ahead of scheduled installation, as not to delay the work of the Contractor. When required, testing of concrete, masonry, soils, pipe and pipe materials will be made in accordance with provisions in the specifications.

7.3 Material required to be tested which is delivered to the job site shall not be incorporated into the work until the tests have been completed and approval or acceptance given in writing by the engineer.

7.4 Each sample submitted by the Contractor for testing shall carry an identification label containing such information as is requested by the engineer. It shall also include a statement that the samples are representative of the remaining materials to be used on the project.

7.5 Approval of any materials shall be general only and shall not constitute a waiver of the owner's right to demand full compliance with the Contract requirements.

7.6 The engineer may, at his own discretion, undertake the inspection of materials at the source. In the event plant inspection is undertaken, the following conditions shall be met:

a. The engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has Contracted for materials.

b. The engineer shall have full entry at all reasonable times to such areas as may concern the manufacture or production of the materials being furnished.

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- c. If required, the Contractor shall arrange for a building for the use of the inspector; such building to be located near the plant, independent of any building used by the material producer, in which to house and use the equipment necessary to carry on the required tests. Cost for such arrangement shall be paid by the owner as a stated allowance in the bid.
 - d. Adequate safety measures shall be provided and maintained at all times.
- 7.7 Except as otherwise specifically stated in the Contract, the costs of sampling and testing will be divided as follows:
- a. The Contractor shall furnish the engineer, without extra cost, all samples required for testing purposes. All sampling and testing including the number and selection of samples shall be determined by the engineer for his own information and use.
 - b. When testing of materials is specified in the appropriate section of the specifications, the cost of the same shall be charged to the owner or Contractor, as detailed in the specifications. However, costs of equipment performance tests shall be borne by the Contractor, as detailed in the appropriate section of the specifications.
 - c. When the Contractor proposes a material, article or component as equal to the ones specified, reasonable tests may, or may not, be required by the engineer. If the engineer requires tests of a proposed equal item, the Contractor will be required to assume all costs of such testing.
 - d. Any material, article or component which fails to pass tests required by the Engineer or by the specifications, will be rejected and shall be removed from the project site. However, if, upon request of the Contractor, retesting or further tests are permitted by the Engineer, the Contractor shall assume all costs related to such retesting or further tests.
 - e. Neither the Owner nor the Engineer will in any way be charged for the manufacturer's costs in supplying certificates of compliance.
- 7.8 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to specifically be inspected, tested or approved by someone other than the Contractor, the Contractor will give the Engineer timely notice of readiness. The Contractor will then furnish the Engineer with the required certificates of inspection, testing or approval.
- 7.9 Inspections, tests, or approvals by the engineer or others shall not relieve the Contractor from obligations to perform the Work in accordance with the requirements of the Contract Documents.
- 8. "Or Equal " Clause, Substitutions and Contractor Options.**
- 8.1 Whenever a material, article, or piece of equipment is identified on the plans or in the specifications by reference to manufacturer's or vendor's names, trade names, catalogue numbers, etc., it is intended merely to establish a standard of quality and performance. Any material, article, or equipment of other manufacturers and vendors, which will perform satisfactorily the duties imposed by the general design, shall be considered equally acceptable provided the material, article, or equipment so proposed is, in the opinion of the Engineer, of equal quality and function. The Engineer shall determine equality based on such information, tests, or other supporting data that may be required of the Contractor.
- 8.2 Upon acceptance and approval by the Engineer of an equal product, it shall remain the responsibility of the Contractor to coordinate installation of the item with all other items to be furnished to assure proper fitting together of all items. Similar responsibility applies to items which are left to the Contractor's option. Any

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additional cost of equal items and any additional cost incidental to the coordination and/or fitting together of such items shall be borne by the Contractor at no extra cost to the Owner.

- 8.3 If a specified or equal item is not available to meet the construction schedule, the Contractor may propose a substitute item of less than equal performance and quality. If this substitute is acceptable to the Engineer, any difference in purchase cost or costs incidental to the installation of such item will be negotiated between the parties to the Contract.
- 8.4 Neither equal nor substitute items shall be installed without written approval of the Engineer.
- 8.5 The Contractor shall warrant that if substitutes are approved, no major changes in the function or general design of the Project will result.
- 9. Patents.** Patent information is as follows:
- 9.1 The Contractor shall hold and save the owner and its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the owner, unless otherwise specifically stipulated in the Contract Documents.
- 9.2 License and/or royalty fees for the use of a process used in wastewater plant design which is authorized by the owner for the project, must be reasonable, and paid to the holder of the patent, or his authorized licensee.
- 9.3 If the Contractor uses any design, device or materials in the construction methods for the project covered by patents or copyrights, he shall provide for such use by suitable agreement with the owner of such patented or copyrighted design, device or material. It is mutually agreed and understood, that, without exception, the Contract prices shall include all royalties or costs arising from the use of such design, device or materials, in any way involved in the work. The Contractor and/or his sureties shall indemnify and save harmless the owner of the project from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or materials or any trademark or copyright in connection with work agreed to be performed under this Contract, and shall indemnify the Owner for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during the construction of the work or after completion of the work.
- 10. Surveys. Surveys of land, property and construction** shall be as follows:
- 10.1 The owner will provide all land surveys and will establish and locate all property lines relating to the project.
- 10.2 For structures, the Engineer will establish and stake out one or more base lines as needed and will establish bench marks in and around the project site for the use of the Contractor and for the Engineer's own reference in checking the work in progress. For structures such as pipelines, the Engineer will establish the location of the pipe, manholes and other appurtenances, and will establish bench marks along the route of the pipeline at intervals for the using of the Contractor and for his own reference in checking the pipe and manhole inverts and other elevations throughout the project. The Contractor shall utilize the lines and bench marks established by the Engineer to set up whatever specific detail controls he may need for establishing location, elevation lines and grades of all structures. All this work is subject to checking, approval, and continuous surveillance by the Engineer to avoid error. The Contractor shall provide the Engineer with a qualified man or men to assist in this checking as needed and on request of the Engineer.
- 10.3 For construction other than pipelines and appurtenances in roadways and cross country, the Contractor shall be responsible for the location and setting lines and grades. The Contractor shall establish the location for pump

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station and wastewater treatment facility structures, associated yard piping including electrical conduits, internal piping and all equipment. Base lines and benchmarks for setting of the lines and grades for the above shall be provided by the Engineer.

- 10.4 Protection of stakes. The Contractor shall protect and preserve all of the established baseline stakes, bench marks, or other controls placed by the Engineer. Any of these items destroyed or lost through fault of the Contractor will be replaced by the Engineer at the Contractor's expense.

11. Contractor's Obligations are as follows:

The Contractor shall and in good workmanlike manner, do and perform all work and furnish and pay for all supplies and materials, machinery, equipment, facilities and means, except as herein otherwise expressly specified, necessary or proper to perform and complete all the work required by this Contract, within the time stated in the proposal in accordance with the plans and drawings covered by this Contract, and any and all supplemental plans and drawings, in accordance with the directions of the Engineer as given from time to time during the progress of the work, whether or not he considers the direction in accordance with the terms of the Contract. He shall furnish, erect, maintain and remove such construction plant and such temporary works as may be required. The Contractor shall observe, comply with, and be subject to all terms, conditions, requirements, and limitations of the Contract Documents, and shall do, carry on and complete the entire work to the satisfaction of the Engineer and Owner.

Contractor shall carry on the work and adhere to the progress schedule during all disputes, disagreements or unresolved claims with the owner. No work shall be delayed or postponed pending the resolution of any disputes, disagreements, or claims except as the owner and Contractor may otherwise agree in writing.

12. Weather Conditions.

In the event of temporary suspension of work, or during inclement weather, or whenever the Engineer shall direct, the Contractor and his Subcontractors shall protect their work and materials against damage or injury from the weather. If, in the opinion of the Engineer, any work or material shall have been damaged or injured by reason of failure on the part of the Contractor or any of his Subcontractors to so protect his work, such materials shall be removed and replaced at the expense of the Contractor.

13. Protection of Work and Property shall be provided as follows:

- 13.1 The Contractor shall at all times safely guard the Owner's property from injury or loss in connection with this Contract. He shall at all times safely guard and protect his own work, and that of adjacent property, from damage. The Contractor shall replace or make good any such damage, loss or injury unless caused directly by errors contained in the Contract, or by the Owner, or his authorized representatives. The Contractor will notify owners of adjacent utilities when prosecution of the Work may affect them.
- 13.2 The Contractor shall take all necessary precautions for the safety of employees on the work site, and shall comply with all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the work is being performed. He shall erect and properly maintain at all times, as required by the conditions and progress of the work, all necessary safeguards for the protection of the workmen and the public and shall post danger signs warning against the hazards created by such features of construction as protruding nails, hoists, well holes, elevator hatchways, scaffolding, window openings, stairways, trenches and other excavations, and falling materials, and he shall designate a responsible member of his organization on the work, whose duty shall be the prevention of accidents. The name and position

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of any person so designated shall be reported to the Engineer by the Contractor. The person so designated shall be available by phone during nonworking hours.

- 13.3 In case of emergency which threatens loss or injury of property, and/or safety of life, the Contractor is allowed to act, without previous instructions from the Engineer. He shall notify the Engineer immediately thereafter. Any claim for compensation by the Contractor due to such extra work shall be promptly submitted in writing to the Engineer for approval.
- 13.4 When the Contractor has not taken action but has notified the Engineer of an emergency threatening injury to persons or damage to the work or any adjoining property, he shall act as instructed or authorized by the Engineer.
- 13.5 The intention is not to relieve the Contractor from acting, but to provide for consultations between Engineer and Contractor in an emergency which permits time for such consultations.
- 13.6 The amount of reimbursement claimed by the Contractor on account of any emergency action shall be determined in the manner provided in Article 17 (extra work and change orders) of the general conditions.

14. Inspection of work for conformance with plans and specifications.

- 14.1 For purposes of inspection and for any other purpose, the Owner, the Engineer, and agents and employees of the Division or of any funding agency may enter upon the work and the premises used by the Contractor, and the Contractor shall provide safe and proper facilities therefore. The Engineer shall be furnished with every facility for ascertaining that the work is in accordance with the requirements and intention of this Contract, even to the extent of uncovering or taking down portions of finished work.
- 14.2 During construction and on its completion, all work shall conform to the location, lines, levels and grades indicated on the drawings or established on the site by the Engineer and shall be built in a workmanlike manner, in accordance with the drawings and specifications and the supplementary directions given from time to time by the Engineer. In no case shall any work which exceeds the requirements of the drawings and specifications be paid for as extra work unless ordered in writing by the Engineer.
- 14.3 Unauthorized work and work not conforming to plans and specifications shall be handled as follows:
 - a. Work considered by the Engineer to be outside of or different from the plans and specifications and done without instruction by the Engineer, or in wrong location, or done without proper lines or levels, may be ordered by the Engineer to be uncovered or dismantled.
 - b. Work done in the absence of the Engineer or his agent may be ordered by the Engineer to be uncovered or dismantled.
 - c. Should the work thus exposed or examined prove satisfactory, the uncovering or dismantling and the replacement of material and rebuilding of the work shall be considered as "Extra Work" to be processed in accordance with article 17.
 - d. Should the work thus exposed or examined prove to be unsatisfactory the uncovering or dismantling and the replacement of material and rebuilding of the work shall be at the expense of the Contractor.

- 15. **Reports, Records and Data** shall be furnished as follows: The Contractor shall submit to the owner such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as are required by the Contract Documents or as the owner, division or any funding agency may request concerning work performed or to be performed under this Contract.

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- 16. Superintendence by Contractor** shall be furnished as follows: At the site of the work, the Contractor shall employ a competent construction superintendent or foreman who shall have full authority to act for the Contractor. The superintendent or foreman shall have been designated in writing by the Contractor as the Contractor's representative at the site. It is understood that such representative shall be acceptable to the Engineer and shall be the one who can be continued in that capacity for the particular job involved unless he ceases to be on the Contractor's payroll. Such representative shall be present on the site at all times as required to perform adequate supervision and coordination of the Work.
- 17. Extra Work and Change Orders** shall be processed as follows:
- 17.1 The Engineer may at any time by written order and without notice to the sureties require the performance of such extra work or changes in the work as may be found necessary. The amount of compensation to be paid to the Contractor for any extra work so ordered shall be made in accordance with one or more of the following methods in the order of precedence listed below:
- a. A price based on unit prices previously approved; or
 - b. A lump sum price agreed upon between the parties and stipulated in the order for the extra work;
 - c. A price determined by adding 15 percent to the "reasonable cost" of the extra work performed, such "reasonable cost" to be determined by the Engineer in accordance with the following paragraph.
- 17.2 The Engineer shall include the reasonable cost to the Contractor of all materials used, of all labor, both common and skilled, of foreman, trucks, and the fair-market rental rate for all machinery and equipment for the period employed directly on the work. The reasonable cost for extra work shall include the cost to the Contractor of any additional insurance that may be required covering public liability for injury to persons and property, the cost of workmen's compensation insurance, federal social security, and any other costs based on payrolls, and required by law. The cost of extra work shall not include any cost or rental of small tools, buildings, or any portion of the time of the Contractor, his project supervisor or his superintendent, as assessed upon the amount of extra work, these items being considered covered by the 15 percent added to the reasonable cost. The reasonable cost for extra work shall also include the premium cost, if any, for additional bonds and insurance required because of the changes in the work.
- 17.3 In the case of extra work which is done by Subcontractors under the specific Contract, or otherwise if so approved by the Engineer, the 15 percent added to the reasonable cost of the work will be allowed only to the Subcontractor performing the work. On such work an additional 5 percent for reasonable cost will be paid to the Contractor for their work in directing the operations of the Subcontractor, for administrative supervision, and for any overhead costs. If two or more tiers of Subcontractors are involved in the extra work, a maximum of 27 percent of the cost incurred by the Subcontractor actually performing the work will be allowed to be added to the reasonable cost of the work. The 27 percent maximum represents 15 percent added to the reasonable cost of the work allowed by the Subcontractor performing the work, an additional 5 percent allowed to the next tier higher subcontractor and 5 percent allowed to the Contractor for their work in directing the operations of the Subcontractor, for administrative supervision, and for any overhead costs.
- 17.4 The Engineer may authorize minor changes or alterations in the work not involving extra cost and not inconsistent with the overall intent of the Contract Documents. These shall be accomplished by a written field order. However, if the Contractor believes that any minor change or alteration authorized by the Engineer entitles him to an increase in the Contract price, he may make a claim therefore as provided in article 21.

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- 18. Time For Completion and Liquidated Damages.** The following paragraphs address time for completion and liquidated damages:
- 18.1 It is hereby understood and mutually agreed, by and between the Contractor and the Owner, that the date of beginning and the time for completion as specified in the Contract of the work to be done hereunder are Essential Conditions of this Contract; and it is further mutually understood and agreed that the work embraced in this Contract shall be commenced on a date to be specified in the "Notice to Proceed."
- 18.2 The Contractor agrees that said work shall be pursued regularly, diligently and continuously at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the Owner, that the time for the completion of the work described herein is a reasonable time, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.
- 18.3 If the Contractor shall neglect, fail or refuse to complete the work within the time herein specified, or any proper extension thereof granted by the Owner, then the Contractor does hereby agree, as a part consideration for the awarding of this Contract, to pay to the Owner the amount specified in the Contract, not as a penalty but as liquidated damages for such breach of Contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the Contract for completing the work.
- 18.4 The liquidated damages amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain. Said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be deducted from time to time by the owner from current periodical payments.
- 18.5 It is further agreed that "time is of the essence" of each and every portion of this Contract and of the specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall "be of the essence." Provided, that the Contractor shall not be charged with liquidated damages or any excess cost when the Owner determines that the Contractor is without fault and the Contractor's reasons for the time extension are acceptable to the Owner; provided, further, that the Contractor shall not be charged with liquidated damages or any excess cost when the delay in the completion of the work is due to:
- a. A preference, priority or allocation order duly issued by the government.
 - b. An unforeseeable cause beyond the control and without the fault or negligence of the Contractor, including, but not restricted to, acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a Contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and severe weather.
 - c. Any delays of Subcontractors or suppliers occasioned by any of the causes specified in subsections (a) and (b) of this article.
- 18.6 The Contractor shall promptly notify the Owner in writing of the causes of the delay. The Owner shall ascertain the facts and extent of the delay and notify the Contractor within a reasonable time of his decision in the matter.

General Conditions**19. Defective Work.** Defective work shall be processed as follows:

- 19.1 The Contractor shall promptly remove from the premises all materials and work condemned by the Engineer as failing to meet Contract requirements, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the Owner and shall bear the expense of making good all work of other Contractors which was destroyed or damaged by such removal or replacement.
- 19.2 All removal and replacement work shall be done at the Contractor's expense. If the Contractor does not take action to remove such condemned work and materials within 10 days after receipt of written notice, the Owner may remove them and store the material at the expense of the Contractor. If the Contractor does not pay the expense of such removal and storage within 10 days time thereafter, the Owner may, upon 10 days written notice, sell such materials at auction or at private sale and shall pay to the Contractor any net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

20. Differing Site Conditions. Claims for differing site conditions shall be processed as follows:

- 20.1 The Contractor shall promptly and before such conditions are disturbed, notify the Engineer in writing of:
- a. Subsurface or latent physical conditions at the site differing materially from those indicated in this Contract; or,
 - b. Unknown physical conditions at the site, differing materially from those ordinarily encountered and generally recognized as inherent in the type of work provided for in this Contract.
- 20.2 The Engineer shall promptly investigate the conditions. If he finds that conditions differ materially and will cause an increase or decrease in the Contractor's cost or the time required to perform any part of the work under this Contract whether or not changed as a result of such conditions, the Engineer will notify the Owner and recommend an equitable adjustment. Contractor and Owner will enter into negotiations via the Engineer to modify the contract in writing.
- 20.3 No claim of the Contractor under this clause shall be allowed unless the Contractor has given proper notice as required in paragraph 20.1 of this clause.
- 20.4 No claim by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this Contract.

21. Claims For Extra Cost. Claims for extra cost shall be processed as follows:

- 21.1 No claim for extra work or cost shall be allowed unless the same was done pursuant to a written order by the Engineer, approved by the Owner and the claim presented for payment with the first estimate after the changed or extra work is done. When work is performed under the terms of article 17, the Contractor shall furnish satisfactory bills, payrolls and vouchers covering all items of cost when requested by the Owner and shall allow the Owner access to accounts relating thereto.
- 21.2 If the Contractor claims that any instructions by drawings or similar documents issued after the date of the Contract involve extra cost under the Contract, he shall give the Engineer written notice after the receipt of such instruction and before proceeding to execute the work, except in an emergency which threatens life or property, then the procedure shall be as provided for under article 17, "Extra Work & Change Orders." No claim shall be valid unless so made.

General Conditions**22. Right of Owner to Terminate Contract.**

- 22.1 In the event that any of the provisions of this Contract are violated by the Contractor, or by any of his Subcontractors, the Owner may serve written notice upon the Contractor and the surety of its intention to terminate the Contract, and unless within 10 days after the serving of such notice upon the Contractor, such violation or delay shall cease and satisfactory arrangement for correction be made, the Contract shall, upon the expiration of said 10 days cease and terminate. In the event of any such termination, the Owner shall immediately serve notice thereof upon the surety and the Contractor and the surety shall have the right to take over and perform the Contract; provided, however, that if the surety does not commence performance thereof within 10 days from the date of the mailing to such surety of notice of termination, the Owner may take over the work and prosecute the same to completion by Contract or by force account for the account and at the expense of the Contractor and the Contractor and his surety shall be liable to the Owner for any excess cost occasioned the Owner thereby, and in such event the Owner may take possession of and utilize in completing the work, such materials, appliances, and plant as may be on the site of the work and necessary therefore.
- 22.2 If the Contractor should be adjudged bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he should refuse or should fail, except in cases for which extensions of time are provided, to supply enough skilled workmen or materials, or if he should fail to make payments to Subcontractors or for material or labor, so as to affect the progress of the work, or be guilty of a violation of the Contract, then the Owner, upon the written notice of the Engineer that sufficient cause exists to justify such action may, without prejudice to any other right or remedy and after giving the Contractor and his surety 7 days' written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools, equipment and other facilities installed on the work and paid for by the Owner, and finish the work by whatever method he may deem expedient. In the case of termination of this Contract before completion from any cause whatever, the Contractor, if notified to do so by the Owner, shall promptly remove any part or all of his equipment and supplies at the expense of the Contractor. If such expense exceeds such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner as herein provided, and the damage incurred through the Contractor's default, shall be approved by the Engineer.
- 22.3 Where the Contract has been terminated by the Owner, said termination shall not affect or terminate any of the rights of the Owner as against the Contractor or his surety then existing or which may thereafter accrue because of such default. Any retention or payment of monies by the Owner due the Contractor under the terms of the Contract, shall not release the Contractor or his surety from liability for his default.
- 22.4 After ten (10) days from delivery of a Written Notice to the Contractor and the Engineer, the Owner may, without cause and without prejudice to any other remedy, elect to abandon the Project and terminate the Contract. In such case the Contractor shall be paid for all Work executed and any expense sustained plus reasonable profit.
- 22.5 If through no act or fault of the Contractor, the work is suspended for a period of more than ninety (90) days by the Owner or under an order of court or other public authority, or the Engineer fails to act on any request for payment within thirty (30) days after approved by the engineer, or the Owner fails to pay the Contractor substantially the sum approved by the Engineer or awarded by arbitrators within thirty (30) days of its approval and presentation, then the Contractor may, after ten (10) days from delivery of a Written Notice to the Owner and the Engineer terminate the Contract and recover from the Owner payment for all Work executed and all expenses sustained. In addition and in lieu of terminating the Contract, if the Engineer has failed to act on a request for payment or if the Owner has failed to make any payment as aforesaid, the Contractor may upon ten (10) days written notice to the Owner and the Engineer stop the Work until paid all amounts then due, in which event and

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upon resumption of the Work Change Orders shall be issued for adjusting the Contract Price or Extending the Contract Time or both to compensate for the costs and delays attributable to the stoppage of the work.

- 22.6 If the performance of all or any portion of the Work is suspended, delayed, or interrupted as a result of failure of the Owner or Engineer to act within the time specified in the Contract Documents, or if no time is specified, within a reasonable time, an adjustment in the Contract Price or an extension of the Contract Time, or both, shall be made by Change Order to compensate the Contractor for the costs and delays necessarily caused by the failure of the Owner or Engineer.

23. Construction Schedule and Periodic Estimates shall provide for the following:

- 23.1 Before starting the work or upon request by the Engineer during its progress, the Contractor shall submit to the Engineer a work plan showing construction methods and the various steps he intends to take in completing the work.
- 23.2 Before the first partial payment is made, the Contractor shall prepare and submit to the Engineer:
- a. A written schedule fixing the dates for submission of drawings; and
 - b. A written schedule fixing the respective dates for the start and completion of segments of the work. Each such schedule shall be subject to review and change during the progress of the work.
 - c. Respective dates for submission of Shop Drawings and for the beginning of manufacture, the testing, and the installation of materials, supplies, and equipment.
 - d. A schedule of payments that the Contractor anticipates will be earned during the course of the Work.

24. Payments to Contractor. Payments to the Contractor shall be made as follows:

- 24.1 Progress payments. The Owner will once each month make a progress payment to the Contractor on the basis of an estimate of the total amount of work done to the time of the estimate and its value as prepared by the Contractor and approved by the Engineer.
- 24.2 Retainage by Owner. The Owner will retain a portion of the progress payment, each month, in accordance with the following procedures:
- a. The Owner will establish an escrow account in the bank of the Owner's choosing. The account will be established such that interest on the principal will be paid to the Contractor. The principal will be the accumulated retainage paid into the account by the Owner. The principal will be held by the bank, available only to the Owner, until termination of the Contract.
 - b. Until the work is 50% complete, as determined by the Engineer, retainage shall be 10% of the monthly payments claimed. The computed amount of retainage will be deposited in the escrow account established above.
 - c. After the work is 50% complete, and provided the Contractor has satisfied the Engineer in quality and timeliness of the work, and provided further that there is no specific cause for withholding additional retainage no further amount will be withheld. The escrow account will remain at the same balance throughout the remainder of the project, unless drawn upon by the Owner in accordance with articles 19, 22, and 56.
 - d. Upon substantial or final completion (as defined in article 25), the amount of retainage will be reduced to 2% of the total Contract Price plus an additional retainage based on the Engineer's estimate of the fair value of

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the punch list items and the cost of completing and/or correcting such items of work, with specified amounts for each incomplete or defective item of work. As these items are completed or corrected, they shall be paid for out of the retainage until the entire project is declared completed (See article 25). The final 2% retainage shall be held during the one-year warranty period and released only after the Owner has accepted the project.

- 24.3 In reviewing monthly estimates for payments of the value of work done, the Engineer may accept in the estimate, prior to subtracting the retainage, the delivered cost of certain equipment and nonperishable material which have been delivered to the site or off-site location and which are properly stored and protected from damage. With the estimate, the Contractor shall submit to the Engineer invoices as evidence that the material has been delivered to the site. Prior to submitting the next monthly estimate, the Contractor shall provide the Engineer with paid invoices or other evidence that the materials have been paid for. If the Contractor fails to submit such evidence, the Engineer may then subtract the value of such materials or equipment for which the Owner has previously paid, from the next monthly estimate. The type of equipment and material eligible for payment prior to being incorporated in the work will be at the Engineer's discretion. Material and equipment made specifically for the subject job will be eligible for payment.
- 24.4 All material and work for which partial payments have been made shall thereupon become the sole property of the Owner. This provision shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of materials and work upon which payments have been made or for the restoration of any damaged work, or as a waiver of the right of the Owner to require compliance with all of the terms of the Contract.
- 24.5 Owner's right to withhold payments and make application. The Contractor agrees that he will indemnify and save the Owner or the Owner's agents harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, material men, and furnishers of machinery and parts, equipment, power, tools and all supplies, including commissary, incurred in the furtherance of the performance of this Contract. The Contractor shall, at the Owner's request, furnish satisfactory evidence that all claims of the nature hereinabove designated have been paid, discharged, or waived. If the Contractor fails to do so, then the Owner may, upon written notice to the Contractor either pay unpaid bills of which the Owner has written notice directly, or withhold from the Contractor's unpaid compensation a sum of money to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged. Payment to the Contractor shall then be resumed in accordance with the terms of this Contract but in no event shall the above provisions be construed to impose any obligations upon the Owner to either the Contractor or his surety or any third party. In paying any unpaid bills of the Contractor, the Owner shall be deemed the agent of the Contractor, and any payment so made by the Owner shall be considered as payment made under Contract by the Owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments made in good faith.
- 24.6 If the Owner fails to make payment forty-five (45) days after approval by the Engineer, in addition to other remedies available to the Contractor, there shall be added to each such payment interest at an annual rate of 10% commencing on the first day after said payment is due and continuing until the payment is received by the Contractor.
- 25. Acceptance and Final Payment** provisions shall be as follows:
- 25.1 Substantial completion and payment.
- a. Substantial completion shall be that point, as certified by the Engineer, at which the Contract or specified part thereof, has been completed to the extent that the Owner may occupy and/or make use of the work

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performed for the purposes for which it was intended. Upon substantial completion there may be minor items, such as seeding, landscaping, etc., yet to be completed or items of work to be corrected.

- b. Upon receipt of written notice from the Contractor that the work is substantially complete, the Engineer shall promptly make an inspection, and when he finds the work complies with the terms of the Contract and the Contract is substantially completed, he will issue a signed and dated certificate, and a list of all items to be completed or corrected, stating that the work required by this Contract has been substantially completed and is accepted by him.
 - c. Upon substantial completion, the entire balance due and payable to the Contractor less 2 percent of the Contract Price, and less a retention based on the Engineer's estimate of the fair value for the cost of completing or correcting listed items of work with specified amounts for each incomplete or defective item of work shall be made.
 - d. The general guarantee period for the work shall begin on the date certified by the Engineer that the work is substantially completed.
- 25.2 Final completion shall be that point at which all work has been completed and all defective work has been corrected. Unless the Engineer has issued a certificate of substantial completion, the general guarantee period shall begin upon certification by the Engineer of final completion.
- 25.3 At the end of the general guarantee period for the entire Contract which has been certified finally completed or substantially completed, the Owner, through the Engineer, shall make a guarantee inspection of all or portions of the work. When it is found that the work is satisfactory and that no work has become defective under the terms of the Contract, the Owner will accept the entire project and make final payment, including the reimbursement of monies retained pursuant to the guarantee period.
- 25.4 If the guarantee inspection discloses any work as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of such work, and the Contractor shall immediately execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the guarantee inspection, provided the work has been satisfactorily completed.
- 25.5 Before issuance of final payment, the Contractor shall certify in writing to the Engineer that all payrolls, material bills, and other indebtedness connected with the work have been paid or otherwise satisfied; except that in case of disputed indebtedness or liens, if the Contract does not include a payment bond, the Contractor may submit in lieu of certification of payment a surety bond in the amount of the disputed indebtedness or liens, guaranteeing payment of all such disputed amounts, including all related costs and interest in connection with said disputed indebtedness or liens which the Owner may be compelled to pay upon adjudication.
- 25.6 If upon substantial completion, full completion is delayed through no fault of the Contractor, and the Engineer so certifies, the Owner may, upon certificate of the Engineer, and without termination of the Contract, make payment of the balance due for that portion of the work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.
- 25.7 The acceptance by the Contractor of final payment shall release the Owner from all claims and all liability to the Contractor for all things relating to this work and for every act and neglect of the Owner and others relating to or arising out of this work. No payment, however, final or otherwise, shall operate to release the Contractor or his sureties from any obligations of the performance and payment bond under this Contract.

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26. Payments by Contractor. The Contractor shall pay the costs:

- 26.1 For all transportation and utility services not later than the 20th day of the calendar month following that in which services are rendered;
- 26.2 For all materials, tools, and other expendable equipment to the extent of 90 percent of the cost thereof, not later than the 20th day of the calendar month following that in which such materials, tools and equipment are delivered at the site of the work and the balance of the cost thereof not later than the 30th day following the completion of that part of the work in or on which such materials, tools and equipment are incorporated or used; and
- 26.3 To each of his Subcontractors, not later than the 5th day following each payment to the Contractor, the respective amounts allowed the Contractor on account of the work performed by his Subcontractors to the extent of each Subcontractor's interest therein.

27. Insurance. The Contractor and any Subcontractor shall obtain all the insurance required under this article and such insurance shall be approved by the Owner.

- 27.1 The Contractor and all Subcontractors shall procure and shall maintain during the life of this Contract workmen's compensation insurance as required by applicable state law. The Contractor shall provide and shall cause each Subcontractor to provide adequate employer's liability insurance.

Limits of Liability: \$100,000 each accident;
 \$500,000 disease - policy limit;
 \$100,000 disease - each employee.

- 27.2 The Contractor shall procure and shall maintain during the life of this Contract Commercial General liability insurance to include Contractual liability, explosion, collapse and underground coverages.

Limits of liability: \$1,000,000 each occurrence bodily injury and property damage;
 \$2,000,000 general aggregate-include per project aggregate endorsement;
 \$2,000,000 products/completed operations aggregate.

If blasting or demolition or both is required by the Contract, the Contractor or Subcontractor shall obtain the respective coverage and shall furnish the Engineer a certificate of insurance evidencing the required coverages prior to commencement of any operations involving blasting or demolition or both.

- 27.3 The Contractor shall procure and shall maintain during the life of this Contract comprehensive automobile liability insurance to include all motor vehicles including owned, hired, borrowed and non-owned vehicles. Limits of liability: \$1,000,000 combined single limit for bodily injury and property damage.

- 27.4 The Contractor shall either:

a. Require each of his Subcontractors to procure and to maintain during the life of his subcontract commercial general liability insurance and comprehensive automobile liability insurance of the type and in the amounts specified in articles 27.2 and 27.3; or

b. Insure the activities of his Subcontractors in his policy.

- 27.5 The required insurance shall provide adequate protection for the Contractor and his Subcontractors, respectively, against damage claims which may arise from work under this Contract, whether such work be by the insured or by anyone employed by him and also against any of the special hazards which may be encountered in the performance of this Contract.

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- 27.6 The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates and dates of expiration of policies. Such insurance shall not be canceled or materially altered, except after 10 days written notice has been received by the Owner.
- 27.7 For builder's risk insurance (fire and extended coverage) and until the work is completed and accepted by the Owner, the Contractor is required to maintain builder's risk type insurance on a 100 percent completed value basis on the insurable portion of the work for the benefit of the Owner, the Contractor, and Subcontractors as their interests may appear.
- 27.8 The Contractor shall take out and furnish to the Owner and maintain during the life of this Contract, complete Owner's protective liability insurance.
- Limits of Liability: \$1,000,000 each occurrence;
\$2,000,000 aggregate.
28. **Contract Security.** The Contractor shall within ten (10) days after the receipt of the Notice of Award furnish the Owner with a performance bond and a payment bond in penal sums equal to the amount of the Contract price conditioned upon the performance by the Contractor of all undertakings, covenants, terms, conditions and agreements of the Contract Documents, and upon the prompt payment by the Contractor to all persons supplying labor and materials in the prosecution of the Work provided by the Contract Documents. Such Bonds shall be executed by the Contractor and a corporate bonding company licensed to transact business in the state in which the Work is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these Bonds shall be borne by the Contractor.
29. **Additional or Substitute Bond.** If at any time a surety on any such Bond is declared as bankrupt or loses its right to do business in the state in which the Work is to be performed, or is removed from the list of Surety Companies accepted on Federal Bonds, the Contractor shall within ten (10) days after notice from the Owner to do so, substitute an acceptable bond (or bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such bond shall be paid by the Contractor. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished such an acceptable bond to the Owner.
30. **Assignments.** The Contractor shall not assign the whole or any part of this Contract or any monies due or to become due hereunder without written consent of the Owner. In case the Contractor assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to prior claims of all persons, firms and corporations for services rendered or materials supplied for the performance of the work called for in this Contract.
31. **Mutual Responsibility of Contractors.** If, through acts of neglect on the part of the Contractor, any other Contractor or any Subcontractor shall suffer loss or damage on the work site, the Contractor agrees to settle with such other Contractor or Subcontractor by agreement or arbitration if such other Contractor or Subcontractors will so settle. If such other Contractor or Subcontractors shall assert any claim against the Owner on account of any damage alleged to have been sustained, the Owner shall notify the Contractor, who shall indemnify and save harmless the Owner against any such claim.

General Conditions**32. Subcontracting.** When subcontracting, the Contractor:

- 32.1 May utilize the services of specialty Subcontractors on those parts of the work which, under usual Contracting practices, are performed by specialty Subcontractors.
- 32.2 Shall be as fully responsible to the Owner for the acts and omissions of his Subcontractors, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.
- 32.3 Shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind Subcontractors to the Contractor by the terms of the Contract Documents insofar as applicable to the work of Subcontractors and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract Documents.
- 32.4 Shall not create any Contractual relation between any Subcontractor and the Owner.
- 32.5 Shall not award Work to Subcontractor(s), in excess of fifty percent (50%) of the Contract Price, without prior written approval of the Owner.

33. Authority of the Engineer. In performing his duties, the Engineer or his representative shall:

- 33.1 Have the authority to suspend the work in whole or in part for such periods as he may deem necessary due to the failure of the Contractor to carry out provisions of the Contract or for failure of the Contractor to suspend work in weather conditions considered by the Engineer to be unsuitable for the prosecution of the work. The Engineer shall give all orders and directions under this Contract, relative to the execution of the work. The Engineer shall determine the amount, quality, acceptability, and fitness of the several kinds of work and materials which are to be paid for under this Contract and shall decide all questions which may arise in relation to the work. The Engineer's estimates and decisions shall be final and conclusive, except as otherwise provided. In case any question shall arise between the parties hereto relative to said Contract or specifications, the determination or decision of the Engineer shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this Contract affected to any extent by such question. The Engineer shall decide the meaning and intent of any portion of the specifications and of any plans or drawings where the same may be found unclear. Any differences or conflicts in regard to their work which may arise between the Contractor under this Contract and other Contractors performing work for the Owner shall be adjusted and determined by the Engineer.
 - a. The purpose of the above article is not in any way to relieve the Contractor of his responsibilities for the safety of workmen or general public in the execution of the work. Attention is drawn to Article 13 of these Conditions which refers to the safety obligations of the Contractor.
 - b. The Engineer, acting on behalf of the Owner, has the authority to enforce corrective action for work not in accordance with the specifications.
 - c. In addition, the Engineer, acting on behalf of the Owner, is to ensure that the work is in accordance with the Contract Documents. He is not held responsible, however, for the methods of construction, sequences, schedules and procedures in the execution of the work. The Engineer does have the opportunity under 33.1 to reject the method of construction, work plan schedule, procedures, as he thinks appropriate.
- 33.2 Appoint assistants and representatives as he desires, and they shall be granted full access to the work under the Contract. They have the authority to give directions pertaining to the work, to approve or reject materials, to suspend any work that is being improperly performed, to make measurements of quantities, to keep records of

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costs, and otherwise represent the Engineer in all matters except as provided below. The Contractor may, however, appeal from their decision to the Engineer himself, but any work done pending its resolution is at the Contractor's own risk. Except as permitted and instructed by the Engineer, the assistants and representatives are not authorized to revoke, alter, enlarge, relax, or release any requirements of these specifications, nor to issue instructions contrary to the plans and specifications. They are not authorized to act as superintendents or foremen for the Contractor, or to interfere with the management of the work by the Contractor. Any advice which the assistants or representatives of the Engineer may give the Contractor shall not be construed as binding the Engineer or the Owner in any way, nor as releasing the Contractor from the fulfillment of the terms of the Contract. All transactions between the Contractor and the representatives of the Engineer which are liable to protest or where payments are involved shall be made in writing.

- 34. Stated Allowances.** The Contractor shall include in his proposal for costs of materials not shown in his bid under "cash allowances" or "allowed materials," any cash allowances stated in the supplemental general conditions or other Contract Documents. The Contractor shall purchase the "allowed materials" as directed by the Owner on the basis of the lowest and best bid of at least 3 competitive bids. If the actual price for purchasing the "allowed materials" is more or less than the "cash allowance," the Contract price shall be adjusted accordingly. The adjustment in Contract price shall be made on the basis of the purchase price without additional charges for overhead, profit, insurance or any other incidental expenses. The cost of installation of the "allowed materials" shall be included in the applicable sections of the Contract specifications covering this work.
- 35. Use of Premises, Removal of Debris, Sanitary Conditions.** In the use of premises or removal of debris, the Contractor expressly undertakes at his own expense: to take every precaution against injuries to persons or damage to property; to maintain sanitary conditions; to store his apparatus, materials, supplies and equipment in such orderly fashion at the site of the work as will not interfere with the progress of his work or the work of any other Contractors; to place upon the work or any part thereof only such loads as are consistent with the safety of that portion of the work; to clean up frequently all refuse, rubbish, scrap materials and debris caused by his operations, to the end that at all times the site of the work shall present an orderly and workmanlike appearance; before final payment to remove all surplus material falsework, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations, and to put the site in an orderly condition; to effect all cutting, fitting or patching of his work required to make the same conform to the plans and specifications and, except with the consent of the Engineer, not to cut or otherwise alter the work of any other Contractor; to provide and maintain in a sanitary condition such toilet accommodations for the use of his employees as may be necessary to comply with the requirements of the state and local boards of health, or of other bodies or authorities having jurisdiction.
- 36. Quantities of Estimate.** Wherever the estimated quantities of work to be done and materials to be furnished under this Contract are shown in any of the documents including the proposal, they are given for use in comparing bids and the right is specifically reserved except as herein otherwise specifically limited, to increase or decrease them as may be deemed reasonably necessary by the Owner to complete the work contemplated by this Contract, and such increase or decrease shall in no way invalidate this Contract, nor shall any such increase or decrease give cause for claims or liability for damages. Such increases or decreases shall not exceed 25 percent of the estimated quantities of work. An increase or decrease in quantities for subsurface materials (e.g. ledge, unsuitable backfill), which overrun or underrun by 25% or more of the bid quantity may be the basis for a Contract price adjustment, at the rate of a negotiated adjusted unit rate. Negotiated unit price rates shall be equitable and shall take into account, but not be limited to the following factors; bid unit rate, distribution of rates and bid balance, and the scope of work as affected by the changed quantities. Claims for extra work resulting from changed quantities shall be processed under article 21.

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- 37. Lands and Rights-of-Way.** Acquisition and usage of lands and rights-of-way shall be as follows:
- 37.1 Prior to issuing the Notice to Proceed, the Owner shall legally obtain all lands and rights-of-way necessary for carrying out and completing the work to be performed under this Contract.
 - 37.2 The Contractor shall not (except after written consent from the Owner) enter or occupy with men, tools, materials, or equipment, any land outside the rights-of-way or property of the Owner. A copy of the written consent shall be given to the Engineer.
 - 37.3 The Owner shall provide to the Contractor information which delineates and describes the lands owned and the rights-of-way acquired.
 - 37.4 The Contractor shall provide at its own expense and without liability to the Owner any additional land and access thereto that the Contractor may desire for temporary construction facilities, or for storage of materials.
- 38. General Guarantee.** With reference to warranties, neither the final certificate of payment nor any provision in the Contract Documents, nor partial or entire occupancy of the premises by the Owner, shall constitute an acceptance of work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any express warranties or responsibility for faulty materials or workmanship. The Contractor shall remedy any defects in the work and pay for any damage to other work resulting therefrom, which appear within the warranty period one year or longer if required by the Contract, from the certified date of completion or substantial completion of the work. The Owner will give notice of observed defects within two working days of their discovery.
- 39. Errors and Inconsistencies.** With reference to errors and inconsistency in Contract Documents, any provisions in any of the Contract Documents which may be in conflict with the paragraphs in these general conditions shall be subject to the following order of precedence for interpretation:
- 39.1 Drawings will govern technical specifications.
 - 39.2 General conditions will govern drawings and technical specifications.
 - 39.3 Supplemental general conditions will govern general conditions, drawings and technical specifications.
 - 39.4 Special conditions will govern supplemental general conditions, general conditions, drawings and technical specifications.
 - 39.5 The Contractor shall take no advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.
 - 39.6 Figure dimensions on Drawings shall govern over general drawings.
- 40. Notice and Service Thereof.** Any notice to the Contractor from the Owner relative to any part of this Contract will be in writing and will be considered delivered and the service completed, when said notice is mailed, by certified registered mail, to the Contractor at his last given address, or delivered in person to the Contractor or his authorized representative on the work.
- 41. Required Provisions Deemed Inserted.** Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein and the Contract shall be read and enforced as though it were included herein, and if through mistake or otherwise any such provision is not inserted or is not correctly

General Conditions

inserted (example; miswording, etc.), then upon the application of either party the Contract shall forthwith be physically amended to make such insertion or correction.

- 42. Protection of Lives and Health.** The work under this Contract is subject to the safety and health regulations (CRF 29, part 1926, and all subsequent amendments) as promulgated by the U.S. Department of Labor on June 24, 1974. Contractors are urged to become familiar with the requirements of these regulations.
- 43. OSHA Construction Safety Program.**
- 43.1 Pursuant to NHRSA 277:5-a, the Contractor shall provide an Occupational Health and Safety Administration (OSHA) 10-hour construction safety program for its on-site employees. All employees are required to complete the program prior to beginning work. The training program shall utilize an OSHA-approved curriculum. Graduates shall receive a card from OSHA certifying the successful completion of the training program.
- 43.2 Any employee required to complete the OSHA 10-hour construction safety program, and who cannot within 15 days provide documentation of completion of such program, shall be subject to removal from the job site.
- 43.3 The following individuals are exempt from the requirements of the 10-hour construction safety program: law enforcement officers involved with traffic control or jobsite security; flagging personnel who have completed the training required by the Department of Transportation; all relevant federal, state and municipal government employees and inspectors; and all individuals who are not considered to be on the site of work under the federal Davis-Bacon Act, including, but not limited to, construction and non-construction delivery personnel and non-trade personnel.
- 44. Equal Employment Opportunity.** Under equal employment opportunity requirements and during the performance of this Contract the Contractor agrees to the following:
- 44.1 The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, national origin, or sex. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, national origin, or sex. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
- 44.2 The Contractor will in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment, without regard to race, creed, color, national origin, or sex.
- 44.3 The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other Contract or understanding, a notice to be provided advising the labor union or worker's representative of the Contractor's commitment under section 202 of executive order no. 11246 of September 24, 1965, and 11375 of October, 13, 1967, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- 44.4 The Contractor will comply with all provisions of executive orders no. 11246 and 11375.
- 44.5 The Contractor will furnish all information and reports required by executive orders no. 11246 and 11375.

General Conditions

- 44.6 In the event of the Contractor's noncompliance with the nondiscrimination clauses of this Contract or with any of such rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part by the Owner or the Department of Labor and the Contractor may be declared ineligible for further government Contracts or federally-assisted construction, however, that in the event the Contractor becomes involved in, or is threatened with, litigation with a Subcontractor or vendor as a result of such direction by the Department of Labor, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.
- 44.7 A breach of this article may be grounds for termination of this Contract and for debarment as provided in 29 CFR 5.6.
- 45. Interest of Federal, State or Local Officials.** No federal, state or local official shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.
- 46. Other Prohibited Interests.** No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, Engineering, inspection, construction or material supply Contract or any subcontract in connection with the construction of the project, shall become directly or indirectly interested personally in this Contract or in any part hereof. No officer, employee, architect, attorney, Engineer or inspector of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall become directly or indirectly interested personally in this Contract or in any part thereof, any material supply Contract, subcontract, insurance Contract, or any other Contract pertaining to the project.
- 47. Use and Occupancy Prior to Acceptance.** Use and occupancy of a portion or unit of the project, upon completion of that portion or unit, and before substantial completion of the project, shall be a condition of this Contract with the following provisions:
- 47.1 The Owner will make his request for use or occupancy to the Contractor in writing.
- 47.2 There must be no significant interference with the Contractor's work or performance of duties under the Contract.
- 47.3 The Engineer, upon request of the Owner and agreement by the Contractor, will make an inspection of the complete part of the work to confirm its status of completion.
- 47.4 Consent of the surety and endorsement of the insurance carrier must be obtained prior to use and/or occupancy by the Owner. Also, prior to occupancy, the Owner will secure the required insurance coverage on the building.
- 47.5 The Owner will have the right to exclude the Contractor from the subject portion of the project after the date of occupancy but will allow the Contractor reasonable access to complete or correct items.
- 47.6 The warranty period shall begin upon substantial completion.
- 48. Suspension of Work.** The Owner may, at any time and without cause, suspend the work or any portion thereof for a period of not more than 90 days by notice in writing to the Contractor and the Engineer. The Owner shall fix the date on which work shall be resumed. The Contractor will be allowed an increase in the Contract price or an extension of the Contract time, or both, directly attributable to any suspension if he makes a claim therefore as provided in articles 17 and 21.

General Conditions

49. [Reserved]

50. [Reserved]

51. [Reserved]

52. **Project Sign.** Furnish and erect a sign at the project site to identify the project and to indicate that the State Government is participating in the development of the project. Place the sign in a prominent location as directed by the Engineer. Do not place or allow the placement of other advertising signboards at the project site or along rights-of-way furnished for the project work. See Exhibit 1 for details of construction.

53. [Reserved]

54. **Public Convenience and Traffic Control** requirements:

54.1 The Contractor shall at all times so conduct his work as to assure minimal obstruction to traffic. The safety and convenience of the general public and the residents along the work site route and the protection of property shall be provided for by the Contractor. The Contractor shall be responsible for timely notification to local residents before causing any interruptions of their access.

54.2 Fire hydrants and water holes for fire protection on or adjacent to the work site shall be kept accessible to fire apparatus at all times, and no obstructions shall be placed within 10 feet of any such facility. No footways, gutters, drain inlets, or portions of highways adjoining the work site shall be obstructed. In the event that all or part of a roadway is officially closed to traffic during construction, the Contractor shall provide and maintain safe and adequate traffic accessibility, satisfactory to the Engineer, for residences and businesses along and adjacent to the roadway so closed.

54.3 When the maintenance of traffic is considered by the Engineer to be minimal, the Contract may not show this work as a pay item. In such cases, the Contractor shall bear all expense of maintaining traffic over the sections of road undergoing improvement and of constructing and maintaining such approaches, crossings, intersections, and other features as may be necessary, without direct reimbursement.

55. **Pre-Construction Conference.** The Contractor shall not commence work until a pre-construction conference has been held at which representatives of the Contractor, Engineer, Division and Owner are present. The pre-construction conference shall be scheduled by the Engineer.

56. **Maintenance During Construction.**

56.1 The Contractor shall maintain the work during construction and until it is accepted by the Owner. This maintenance shall be continuous and effective work prosecuted day by day, with adequate equipment and forces, to the end that roads or structures are kept in satisfactory condition at all times.

56.2 All cost of maintenance during construction and before the work is accepted by the Owner shall be included in the unit prices bid on the various pay items and the Contractor shall not be paid an additional amount for such maintenance.

56.3 If the Contractor, at any time, fails to comply with the provisions above, the Engineer may direct the Contractor to do so. If the Contractor fails to remedy unsatisfactory maintenance within the time specified by the Engineer, the Engineer may immediately cause the project to be maintained and the entire cost of this maintenance will be deducted from money to become due the Contractor on this Contract.

General Conditions**57. Cooperation with Utilities.**

- 57.1 The Owner will notify all utility companies, all pipe line owners, or other parties affected, and have all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction made as soon as practicable.
- 57.2 Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals, and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted are to be moved by the owners of such utilities at their expense, except as may otherwise be provided for in the special conditions or as noted on the plans.
- 57.3 It is understood and agreed that the Contractor has considered in his bid all of the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans and as evident on the site, and that no additional compensation will be allowed for any delays, inconvenience, damage sustained by him due to any interference from such utility appurtenances or the operation of moving them.
- 57.4 The Contractor shall cooperate with the Owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner, that duplication of rearrangements may be reduced to a minimum, and that services rendered by those parties will be minimal.
- 57.5 In the event of interruption to a water or utility service as a result of accidental breakage or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate with said authority in the restoration of services. If water service is interrupted, repair work shall be continuous until the service is restored. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority. If any utility service is interrupted for more than 4 hours, the Contractor shall make provisions for temporary service at his own expense until service is resumed.

58. Work Performed at Night and on Sundays and Holidays shall comply with the following:

- 58.1 No work will be permitted at night or on Sundays or holidays except as approved in writing by the Engineer, and provided such work is not in violation of a local ordinance. When working at night, the Contractor shall provide flood lighting sufficient to insure the same quality of workmanship and the same conditions regarding safety as would be achieved in daylight.
- 58.2 Whenever Memorial Day or Fourth-of-July is observed on a Friday or a Monday and during the weekend of Labor Day, the Contractor may be required to suspend work for the 3 calendar days. Prior to the close of work, the work site shall be placed in a condition acceptable to the Engineer for the comfort and safety of the traveling public. An arrangement shall be made for responsible personnel acceptable to the Engineer to maintain the project in the above conditions.

59. Laws to be Observed. With reference to laws that shall be observed:

- 59.1 The Contractor shall keep fully informed of all federal and state laws, all local laws, ordinances, and regulations, and all orders and decrees of tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work. He shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the state and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by himself or his employees.

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59.2 Indemnification

The Contractor will indemnify and hold harmless the Owner and the Engineer and their agents and employees from and against all claims, damages, losses, and expenses including attorney's fees arising out of or resulting from the performance of the Work, provided that any such claims, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use resulting therefrom; and is caused in whole or in part by any negligent or willful act or omission of the Contractor, and Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

In any and all claims against the Owner or the Engineer, or any of their agents or employees, by any employees of the Contractor, and Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by disability benefit or other employee benefit acts.

The obligation of the Contractor under this paragraph shall not extend to the liability of the Engineer, his agents or employees arising out of the preparation or approval of maps, Drawings, opinions, reports, surveys, Change Orders, designs or Specifications.

60. Permits. Permits to be obtained by the Contractor shall be in accordance with the following:

- 60.1 Permits and licenses of a temporary nature necessary for the prosecution of the work shall be obtained and paid for by the Contractor. Permits, licenses and easements for permanent structures or permanent changes in existing facilities will be secured and paid for by the Owner. Permits may include:
- a. New Hampshire Department of Transportation Highway Trench Permits.
 - b. RSA 485-A:17 and 483-A N.H. DES Wetlands Bureau Dredge and Fill Permit.
 - c. RSA 485-A:17 - N.H. DES Site Specific Permit (Water Quality)
 - d. RSA 149-M:10 N.H. DES Solid Waste Management Bureau - disposal of construction debris and/or demolition waste.
 - e. N.H. Department of Environmental Services Air Resources Division (burning permits).
 - f. Other permits, as required by State and Local laws and ordinances.
 - g. Notice of intent for coverage under EPA's General NPDES Permit for construction dewatering activities.

61. Control of Pollution due to construction shall comply with the following:

- 61.1 During construction, the Contractor shall take precautions sufficient to avoid the leaching or runoff of polluting substances such as silt, clay, fuels, oils, bitumens, calcium chloride and any other polluting materials which are unsightly or which may be harmful to humans, fish, or other life, into groundwaters and surface waters of the State.
- 61.2 In waters used for public water supply or used for trout, salmon, or other game or forage fish spawning or nursery, control measures must be adequate to assure that turbidity in the receiving water will be increased not more than 10 standard turbidity units (s.t.u.) in the absence of other more restrictive locally-established limitations, unless otherwise permitted by the Division. In no case shall the classification for the surface water be violated.

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61.3 In water used for other purposes, the turbidity must not exceed 25 s.t.u. unless otherwise permitted by the Division.

62. Use of Explosives.

- 62.1 When the use of explosives is necessary for the prosecution of the Work, exercise the utmost care not to endanger life or property. The Contractor shall be responsible for any and all damage resulting from the use of explosives.
- 62.2 Store all explosives in a secure manner, in compliance with all State and local laws and ordinances, and legally mark all such storage places. Storage shall be limited to such quantity as may be needed for the work underway.
- 62.3 Designate as a "Blasting Area" all sites where electric blasting caps are located and where explosive charges are being placed. Mark all blasting areas with signs as required by law. Place signs as required by law from each end of the blasting area and leave in place while the above conditions prevail. Immediately remove signs after blasting operations or the storage of caps is over.
- 62.4 Notify each property Owner and public utility company having structures in proximity to the site of the work sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property. Such notice shall not relieve the Contractor of any of his responsibility for damage resulting from his blasting operation. Warn all persons within the danger zone of blasting operations and do not perform blasting work until the area is cleared. Provide sufficient flagmen outside the danger zone to stop all approaching traffic and pedestrians. Provide watchmen during the loading period and until charges have been exploded. Place adequate protective covering over all charges before being exploded.

63. Arbitration by Mutual Agreement.

- 63.1 All claims, disputes, and other matters in question arising out of, or relating to, the Contract Documents or the breach thereof, except for claims which have been waived by making an acceptance of final payment as provided in Section 25, may be decided by arbitration if the parties mutually agree. Any agreement to arbitrate shall be specifically enforceable under the prevailing arbitration law. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.
- 63.2 Notice of the request for arbitration shall be filed in writing with the other party to the Contract Documents and a copy shall be filed with the Engineer. Request for arbitration shall in no event be made on any claim, dispute, or other matter in question which would be barred by the applicable statute of limitations.
- 63.3 The Contractor will carry on the Work and maintain the progress schedule during any arbitration proceedings, unless otherwise mutually agreed in writing.

64. Taxes. The Contractor shall pay all sales, consumer, use, and other similar taxes required by the laws of the place where the Work is performed.

65 Separate Contracts.

65.1 The Owner reserves the right to let other Contracts in connection with this Project. The Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and the execution of their Work, and shall properly connect and coordinate the Work with theirs. If the proper execution or results of any part of the Contractor's Work depends upon the Work of any other Contractor, the Contractor shall inspect

General Conditions

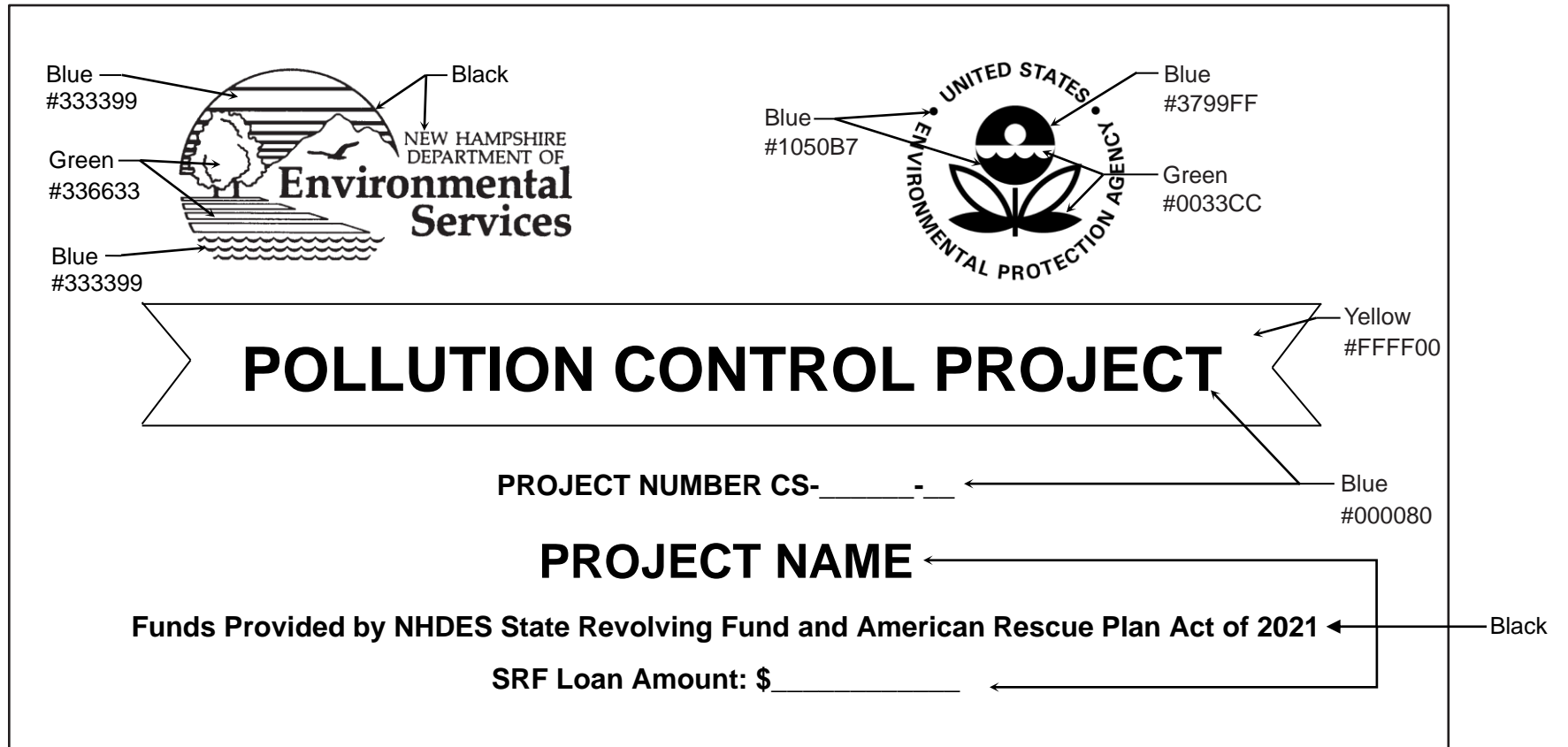
and promptly report to the Engineer any defects in such Work that render it unsuitable for such proper execution and results.

- 65.2 The Owner may perform additional Work related to the Project or the Owner may let other Contracts containing provisions similar to these. The Contractor will afford the other Contractors who are parties to such Contracts (or the Owner, if the Owner is performing the additional Work) reasonable opportunity for the introduction and storage of materials and equipment and the execution of the Work, and shall properly connect and coordinate the Work with theirs.
- 65.3 If the performance of the additional Work by other Contractors or the Owner is not noted in the Contract Documents prior to the execution of the Contract, written notice shall thereof be given to the Contractor prior to starting such additional Work. If the Contractor believes that the performance of such additional Work by the Owner or others involves it in additional expense or entitles it to an extension of the Contract Time, the Contractor may make a claim thereof as provided in Sections 17 and 18.

General Conditions

Exhibit 1

Project Sign Detail



4'-0" x 8'-0" x 3/4" HIGH DENSITY OVERLAY
PLYWOOD SIGNBOARD OR OTHER APPROVED
MATERIAL SUITABLE FOR SIGNS

PROVIDE 4" x 4" SIGN POSTS OR OTHER
ADEQUATE SUPPORTS TO MOUNT SIGN AT
APPROVED LOCATION

NHDES Front End Documents Section D: Federal Provisions Rules Regulations and Forms

Section D: Federal Provisions Rules Regulations and Forms

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Links to Other NHDES Front End Documents

[NHDES Front End Documents: Section A Bidding Requirements](#)

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[NHDES Front End Documents: Section C General Conditions](#)

Pertinent Federal Acts and Provisions

The Contractor shall comply with the regulations of the Davis-Bacon Act, the Contract Work Hours Standards Act, Executive Order 11246 (Federal Equal Employment Opportunity), and Title X of the Clean Air Act Amendments of 1990 (Disadvantage Business Enterprise), and any amendments or modifications thereto. The Contractor shall cause appropriate provisions to be inserted in subcontracts to ensure compliance with the above acts by all Subcontractors, as applicable.

The Contractor shall comply with the American Iron and Steel requirements of the Water Resources Reform and Development Act of 2014, the Consolidated Appropriations Act of 2014 (Public Law 113-76), and subsequent laws that continue the requirement for the use of American Iron and Steel products in State Revolving Fund construction projects.

The Contractor shall comply with Subpart B and Subpart C of 2 CFR Part 180 and 2 CFR Part 1532. By entering into this contract, the contractor certifies that neither the contractor's firm, nor any person or firm who has an interest in the contractor firm, is a debarred or suspended person or firm. Furthermore, by entering into this contract, the contractor certifies that no part of this contract will be subcontracted to a debarred or suspended person or firm. Contractors may access the federal government's Excluded Parties List System for verification of excluded parties at the following website: <http://www.sam.gov>.

The Contractor shall comply with prohibition on certain telecommunications and video surveillance services or equipment. This term and condition implements 2 CFR 200.216 and is effective for obligations and expenditures of EPA financial assistance funding on or after 8/13/2020. As required by 2 CFR 200.216, EPA recipients and subrecipients, including borrowers under EPA funded revolving loan fund programs, are prohibited from obligating or expending loan or grant funds to procure or obtain; extend or renew a contract to procure or obtain; or enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that use covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115-232, section 889, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities). Recipients, subrecipients, and borrowers also may not use EPA funds to purchase:

- a. For the purpose of public safety, security of government facilities, physical security surveillance of critical Page 4 of 29 infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).
- b. Telecommunications or video surveillance services provided by such entities or using such equipment.
- c. Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

Consistent with 2 CFR 200.471, costs incurred for telecommunications and video surveillance services or equipment such as phones, internet, video surveillance, and cloud servers are allowable except for the following circumstances:

- a. Obligating or expending EPA funds for covered telecommunications and video surveillance services or equipment or services as described in 2 CFR 200.216 to:
 - (1) Procure or obtain, extend or renew a contract to procure or obtain;
 - (2) Enter into a contract (or extend or renew a contract) to procure; or
 - (3) Obtain the equipment, services, or systems. Certain prohibited equipment, systems, or services, including equipment, systems, or services produced or provided by entities identified in section 889, are recorded in the [System for Award Management](#) exclusion list.

Links for more Information

- [U.S.DOL Prevailing Wage Resources](#)
- [General Wage Determinations](#)
- [U.S. DOL Certified Payroll Form WH-347](#)
- [WH-1321 "Employee Rights Under the Davis-Bacon Act" poster](#)
- [EPA's DBE Resources](#)
- [NHDOT Certified Disadvantaged Business Enterprise \(DBE\) Directory](#)
- [EPA American Iron and Steel \(AIS\) Requirement - Guidance and Questions and Answers website](#)
- [AIS Approved National Waivers](#)
- [Sole Source Aquifers \(SDWA\)](#)
- [Protection and Enhancement of the Cultural Environment \(1971\)](#)
- [Fish and Wildlife Coordination Act](#)
- [Migratory Bird Treaty Act of 1918](#)
- [Systems for Award Management exclusion list](#)

**CONTRACTOR’S PAYROLL CERTIFICATION
AND
AMERICAN IRON AND STEEL CERTIFICATION**

PUBLIC LAW: 113-76

This form will be submitted with each disbursement request.

Project Name: Ledgeview Sewer Pump Station Upgrade		Project Number: CS-334122-21	
Project Location: 54A Ledgeview Drive, Rochester, NH 03839			
Contractor Name:			
Contractor Address:			
Street # and name		City/Town	State ZIP
Payment Application #		Payment Application End Date	

I hereby certify that all of the contract requirements as specified under the Labor Standards Provision for Federal and Federally Assisted Contracts have been complied with by the above named Contractor, and by each Subcontractor employing Laborers or Mechanics at the site of the work, or there is an honest dispute with respect to the required provisions.

I hereby certify that the “American Iron and Steel” provisions of the Water Resources Reform and Development Act of 2014, the Consolidated Appropriations Act of 2014 ([Public Law 113-76](#)), and subsequent laws that continue the requirement for the use of American Iron and Steel products in State Revolving Fund construction projects as applicable, have been met, and that all iron and steel used in the project named above have been produced in the United States in a manner that complies with American Iron and Steel Requirements, and/or that applicable EPA-approved waivers have been obtained to comply with American Iron and Steel requirements.

Contractor Signature:	Printed Name:
Title:	Date:

**NOTICE TO LABOR UNIONS OR OTHER ORGANIZATIONS OF WORKERS
NONDISCRIMINATION IN EMPLOYMENT**

PUBLIC LAW: 41 CFR Part 60-1.4(b)-3.1

THIS DOCUMENT MUST BE COMPLETED BY THE SUCCESSFUL BIDDER AND BOUND IN THE EXECUTED CONTRACT

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

_____ (Union or Organization). The undersigned currently holds contract(s) with _____ (Applicant) involving funds or credit of the U.S. Government or (a) subcontract(s) with a prime contractor holding such contract(s).

You are advised that under the provisions of the above contract(s) or subcontract(s) and in accordance with Executive Order 11246, dated September 24, 1965, Executive Order 13665 dated April 8, 2014 and Executive Order 13672 dated July 21, 2014, the undersigned is obliged not to discriminate against any employee or applicant for employment because of race, color, religion, national origin, sexual orientation or gender identity. This obligation not to discriminate in employment includes, but is not limited to, the following

HIRING, PLACEMENT, UPGRADING, TRANSFER, OR DEMOTION RECRUITMENT, ADVERTISING, OR SOLICITATION FOR EMPLOYMENT TRAINING DURING EMPLOYMENT, RATES OF PAY OR OTHER FORMS OF COMPENSATION, SELECTION FOR TRAINING INCLUDING APPRENTICESHIP, LAYOFF, OR TERMINATION.

<input type="checkbox"/> Contractor	<input type="checkbox"/> Subcontractor
Signature:	Printed Name:
Title:	Date:

COPIES OF THIS NOTICE WILL BE POSTED BY THE ABOVE SIGNED IN CONSPICUOUS PLACES AVAILABLE TO EMPLOYEES OR APPLICANTS FOR EMPLOYMENT.

EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS (EO11246)

(Executive Order 11246, as amended)

The Contractor shall comply with the equal opportunity requirements of Executive Order 11246, as amended, and as supplemented by 41 CFR Part 60, including the Equal Opportunity Clause at 41 CFR Part 60-1.4(b), and specific affirmative action obligations required by the Standard Federal Equal Employment Opportunity Construction Contract Specifications, as set forth in 41 CFR Part 60-4.

A. Equal Opportunity Clause (41 CFR Part 60-1.4(b))

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

1. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.
3. The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.
4. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
5. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
6. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

7. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
8. The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided*, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

B. Federal Equal Employment Opportunity Construction Contract Specifications (41 CFR Part 60-4.3)

1. As used in these specifications:
 - a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
 - b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
 - c. "Employer identification number" means the Federal Social Security number used on the employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
 - d. "Minority" includes:
 - (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
 - (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands); and
 - (iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).
2. Whenever the Contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000.00 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.
3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under

the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through p of these specifications. The Goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction Contractors performing construction work in geographical areas where they do not have a Federal or federally-assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the *Federal Register* in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.
5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.
6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.
7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
 - a. Ensure and maintain a working environment free of harassment, intimidation and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
 - b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organization responses.
 - c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore, along with whatever additional actions the Contractor may have taken.
 - d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by

the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligation.

- e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.
- f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to an discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.
- i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
- j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.
- k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
- l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
- m. Ensure that seniority practices, job classifications, work assignments and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.
- n. Ensure that all facilities and company activities are non-segregated, except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

- o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
 - p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.
8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female work force participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.
 9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner
 10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.
 11. The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.
 12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.
 13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.
 14. The Contractor shall designate a responsible official to monitor all employment-related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, Contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

CERTIFICATION OF NONSEGREGATED FACILITIES

Public Law: 41 CFR 60 (a) §60-1.8

APPLICABLE TO FEDERALLY ASSISTED CONSTRUCTION CONTRACTS AND RELATED SUBCONTRACTS EXCEEDING \$10,000 WHICH ARE NOT EXEMPT FROM THE EQUAL OPPORTUNITY CLAUSE.

THIS DOCUMENT MUST BE COMPLETED BY THE SUCCESSFUL BIDDER AND BOUND IN THE EXECUTED CONTRACT.

The federally assisted construction contractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained.

The federally assisted construction contractor certifies that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin cannot result.

The federally assisted construction contractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract.

As used in this certification, the term "segregated facilities" means any waiting rooms, work area, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, sexual orientation, gender identity or national origin, because of habit, local custom, or otherwise.

The federally assisted construction contractor agrees that (except where he had obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause, and that he will retain such certification in his files

<input type="checkbox"/> Contractor	<input type="checkbox"/> Subcontractor
Signature:	Printed Name:
Title:	Date:

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

Disadvantaged Business Enterprises Rule- Program Requirements

Purpose: The Environmental Protection Agency (EPA) rule titled “Participation by Disadvantaged Business Enterprises in United States Environmental Protection Agency Programs”, at 40 CFR Part 33 (DBE Rule), sets forth an EPA program that serves the compelling government interest to increase and encourage the utilization and participation of Disadvantaged Business Enterprises (DBEs) in procurements funded by EPA assistance agreements. Because the New Hampshire State Revolving Fund (SRF) Loan Programs receive funding from EPA, the DBE rule requirements apply to all SRF funded projects.

State Revolving Fund loan recipients and their contractors must comply with the following DBE Rule requirements throughout the SRF loan project period:

1. Good Faith Efforts.
2. Annual Reporting of MBE/WBE accomplishments (for projects that exceed \$250,000).
3. Contract Administration Requirements.
4. Bidders List Requirements.
5. Other Reporting.

The NHDES SRF programs must ensure that contracts and subcontracts that are funded with SRF loans comply with these federal requirements and must report to EPA on DBE accomplishments.

1. Good Faith Efforts

The Contractor shall make the following good faith efforts whenever procuring construction, equipment, services and supplies:

- a. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities; including placing DBEs on solicitation lists and soliciting them whenever they are potential sources.
- b. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
- c. Consider in the contracting process whether firms competing for large contracts could be contracted with DBEs. This will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.
- d. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.
- e. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the U. S. Department of Commerce.
- f. Contractor shall maintain all records documenting Contractor’s compliance with the requirements of 40 CFR Part 33, including documentation of Contractor’s good faith efforts. Such records shall be provided to Owner upon request.

2. Annual Reporting of MBE/WBE Accomplishments

The Owner is required to report MBE/WBE utilization accomplishments to NHDES by October 15 of each year. The Contractor shall keep records of its MBE/WBE utilization, and prepare periodic reports in a timely manner as requested by the Owner to allow the Owner to complete and submit the required annual MBE/WBE reports to NHDES by the October 15 deadline. Contractor’s utilization reports shall include the following for all MBE/WBE costs incurred in the reporting period (i.e., the October 1 through September 30 federal fiscal year):

- a. Name, address and telephone number of MBE/WBE

- b. Business enterprise status (MBE or WBE)
- c. Dollar value of cost(s) (Amount(s) paid to MBE/WBE in reporting period)
- d. Date(s) of cost(s) (Date(s) of payment(s) to MBE/WBE, mm/dd/yyyy)
- e. Type of product or services (Construction/Supplies/Services/Equipment)

Note that only costs incurred with certified MBE/WBE's are counted as MBE/WBE accomplishments.

{NOTE TO ENGINEER: This annual reporting requirement may not apply if the total funding budgeted for the project does not exceed \$250,000. Contact NHDES for guidance if you think this reporting requirement may not apply to your project}

3. Contract Administration Requirements

The Contractor shall:

- a. Pay all subcontractors for satisfactory performance no more than 30 days from the prime contractor's receipt of payment from the loan recipient.
- b. Notify Owner in writing prior to the termination of any DBE subcontractor for Contractor's convenience.
- c. Employ the good faith efforts when soliciting a replacement subcontractor if a DBE subcontractor fails to complete work under the subcontract for any reason.
- d. Employ the good faith efforts even if the prime contractor has achieved its fair share objective
- e. Comply with the following term and condition, as required by 40 CFR, Section 33.106:

The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies. (Appendix A to 40 CFR Part 33—Term and Condition)

4. Bidders List Requirements

The Owner is required to maintain a bidders list in accordance with 40 CFR Section 33.501, and the Contractor shall provide bidders list information to the Owner for Owner's use in complying with this requirement. The Contractor shall maintain a Bidders List, which must include all firms that bid or quote on subcontracts under this Contract, including both MBE/WBEs and non-MBE/WBEs.

The Bidders List shall include the following information for all subcontractors who submit bids or quotes for subcontract work:

- (a) Entity's name with point of contact;
- (b) Entity's mailing address, telephone number, and e-mail address;
- (c) The procurement on which the entity bid or quoted, and when; and
- (d) Entity's status as an MBE/WBE or non-MBE/WBE.

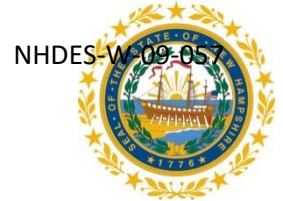
6. Other Reporting

- a. DBE Subcontractor Performance and Utilization Forms
The Bidder shall submit with its bid completed DBE Subcontractor Performance Forms NHDES W-09-58(formally EPA Form 6100-3), and DBE Subcontractor Utilization Form NHDES W-09-59(formally EPA Form 6100-4). The Owner is required to submit these forms to NHDES when requesting authorization to award the construction contract.
- b. DBE Subcontractor Participation form
The contractor shall provide a copy of the DBE Subcontractor Participation Form NHDES-W-09-57 (formally EPA Form 6100-2) to each of its DBE subcontractors.
- c. Bidders List Reporting

The Contractor shall provide the updated Bidders List to the Owner periodically upon Owner’s request, and at project substantial completion.



**DISADVANTAGED BUSINESS ENTERPRISE
(DBE) PROGRAM
SUBCONTRACTOR PARTICIPATING FORM
CLEAN WATER AND DRINKING WATER
STATE REVOLVING LOAN FUND**



FEDERAL RULE: 40 CFR Part 33

FORMERLY EPA-6100-2

An EPA Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE¹ subcontractor² the opportunity to describe work received and/or report any concerns regarding the EPA-funded project. (e.g., in areas such as termination by prime contractor, late payments, etc.) The DBE subcontractor can as an option, complete and submit this form to other EPA DBE Coordinator at any time during the project period of performance.

Subcontractor Name:		Project Name: Ledgeview Sewer Pump Station Upgrade	
Bid/Proposal No:	Assistance Agreement ID: (if known)	Point of Contact:	
Address:			
Street # and Name		City/Town	State ZIP
Telephone No:		Email:	
Prime Contractor Name:		Issuing Funding Entity:	
Contract Item Number	Description of Work Receive from the Prime Contractor Involving Construction, Services, Equipment or Supplies	Amount Received by Prime Contractor	
Please use the space below to report any concerns regarding the above EPA-funded project:			
Subcontractor Signature:		Printed Name:	
Title:		Date:	

¹ A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from with EPA accepts certifications as described in 40CFR 33.204-33.205. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

² Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

NHDES-W-09-058



**DISADVANTAGED BUSINESS ENTERPRISE
(DBE) PROGRAM
SUBCONTRACTOR PERFORMANCE FORM**
NHDES CLEAN WATER AND DRINKING WATER STATE
REVOLVING LOAN FUND



FEDERAL RULE: 40 CFR Part 33

FORMERLY EPA FORM 6100-3

This form is intended to capture the DBE³ subcontractor's⁴ description of work to be performed and the price of the work submitted to the prime contractor. An EPA Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractor's bid or proposal package. You will find NHDES bid information in [Section A](#) of the front-end documents.

Subcontractor Name:		Project Name: Ledgeview Sewer Pump Station Upgrade	
Bid/Proposal No:	Assistance Agreement ID: (if known)	Point of Contact:	
Address:			
Street # and Name		City/Town	State ZIP
Telephone No:		Email:	
Prime Contractor Name:		Issuing Funding Entity:	
Contract Item Number	Description of Work Submitted to the Prime Contractor Involving Construction, Services, Equipment or Supplies	Price of work submitted to the Prime Contractor	
DBE Certified by: <input type="checkbox"/> DOT <input type="checkbox"/> SBA <input type="checkbox"/> Other:		Meets/exceeds EPA Certification Standards? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	
Prime Contractor Signature:		Printed Name:	
Title:		Date:	
Subcontractor Signature:		Printed Name:	
Title:		Date:	

³ A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from with EPA accepts certifications as described in 40CFR 33.204-33.205. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

⁴ Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

NHDES-W-09-059

**DISADVANTAGED BUSINESS ENTERPRISE
(DBE) PROGRAM
SUBCONTRACTOR UTILIZATION FORM**



CLEAN WATER AND DRINKING WATER
STATE REVOLVING LOAN FUND



FEDERAL RULE: 40 CFR Part 33

FORMERLY EPA FORM 6100-4

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE subcontractors and the estimated dollar amount of each subcontract. An EPA Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposed package. Prime contractors should also maintain a copy of this form on file. You will find NHDES bid information in [Section A](#) of the front-end documents.

THIS DOCUMENT MUST BE COMPLETED BY THE SUCCESSFUL BIDDER AND BOUND IN THE EXECUTED CONTRACT

Prime Contractor Name:		Project Name: Ledgeview Sewer Pump Station Upgrade	
Bid/Proposal No:	Assistance Agreement ID: (if known)	Point of Contact:	
Address:			
Street # and Name		City/Town	State ZIP
Telephone No:		Email:	
Issuing Funding Entity:			
I have identified potential DBE certified subcontractors:		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes please complete the table below. If no, please explain:			
Subcontractor Name Company Name	Company Contact Information Street Number and Name, City/Town, State, ZIP Phone and Email	Est. Dollar Amount	Currently DBE Certified?
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to use the subcontractors above. I am aware that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302(c).			
Prime Contractor Signature:		Printed Name:	
Title:		Date:	

NHDES-W-09-061



**NEW HAMPSHIRE STATE REVOLVING FUND:
BIDDERS LIST**
NHDES CLEAN WATER AND DRINKING WATER
STATE REVOLVING LOAN FUND



PUBLIC LAW: 40 CFR § 33.501

The Contractor shall maintain and submit to the owner a bidders list, which the owner will use for compliance with the recordkeeping requirements of 40 CFR § 33.501. The list must include information regarding all entities that bid or quote on subcontracts under this contract, including both MBEs/WBEs and non-MBEs/WBEs. Projects funded by loan(s) of \$250,000 or less may be exempt from the requirement to maintain a bidders list [reference 40 CFR § 33.501(c)].

Project Name and Number: Ledgeview Sewer Pump Station Upgrade				Prime Contractor:		
Contact Information to include Company Name, Contact Name, Phone, Street Address, Town/City, Email, State/ZIP			Contract Item Number and Work Description Item # Description		Bid/Quote Date	Entity Status MBEs/WBEs
					/ /	<input type="checkbox"/> Yes <input type="checkbox"/> No
() -					/ /	
					/ /	<input type="checkbox"/> Yes <input type="checkbox"/> No
() -					/ /	
					/ /	<input type="checkbox"/> Yes <input type="checkbox"/> No
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					/ /	<input type="checkbox"/> Yes <input type="checkbox"/> No
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					/ /	<input type="checkbox"/> Yes <input type="checkbox"/> No
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					/ /	<input type="checkbox"/> Yes <input type="checkbox"/> No
() -					/ /	

American Iron and Steel

The Water Resources Reform and Development Act of 2014, the Consolidated Appropriations Act of 2014 ([Public Law 113-76](#)), and subsequent laws that continue the American Iron and Steel requirements of Public Law 113-76 include “American Iron and Steel (AIS)” requirements for the Clean Water and Drinking Water State Revolving Fund (SRF) programs. Under these laws, all Clean Water and Drinking Water SRF funded construction, alteration, maintenance, or repair of public water systems or treatment works projects must use iron and steel products that are produced in the United States. The Contractor shall comply with these AIS requirements.

1. EPA AIS Guidance

[EPA’s State Revolving Fund American Iron and Steel Requirement](#) website includes detailed information on American Iron and Steel requirements and waivers.

The paragraphs in *italics* below are excerpts from the EPA AIS guidance available at the EPA website. Words in plain text are clarifications added by NHDES.

(a) Iron and Steel Products ^[5]

An iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the project:

- *Lined or unlined pipes and fittings.*
- *Manhole covers.*
- *Municipal castings (defined in more detail below).*
- *Hydrants.*
- *Tanks.*
- *Flanges.*
- *Pipe clamps and restraints.*
- *Valves.*
- *Structural steel (defined in more detail below).*
- *Reinforced precast concrete and.*
- *Construction materials (defined in more detail below).*

(b) Permanently Incorporated into the Project⁶

Only items on the above list made primarily of iron or steel, permanently incorporated into the project must be produced in the US. For example, trench boxes, scaffolding or equipment, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel.

(c) Primarily Iron or Steel⁷

Primarily iron or steel places constraints on the list of products above. For one of the listed products to be considered subject to the AIS requirements, it must be made of greater than 50% iron or steel, measured by cost. The cost should be based on the material costs.⁸

⁵ EPA guidance dated March 20, 2014, Question 11.

⁶ EPA guidance dated March 20, 2014, Question 18.

⁷ EPA guidance dated March 20, 2014, Question 12.

⁸ See example at EPA guidance March 20, 2014, Question 13.

(d) If a product is composed of more than 50% iron or steel, but is not listed in the above list of items, must the item be produced in the US? Alternatively, must the iron or steel in such a product be produced in the US?⁹

The answer to both question is no. Only items on the above list must be produced in the US. Additionally, the iron or steel in a non-listed item can be sourced from outside the US.

(e) Steel¹⁰

Steel means an alloy that includes at least 50 percent iron, between .02 and 2 percent carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. The definition of steel covers carbon steel, alloy steel, stainless steel, tool steel and other specialty steels.

(f) Production in the United States¹¹

Production in the United States of the iron or steel products used in the project requires that all manufacturing processes¹², including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes includes processes such as melting, refining, forming, rolling, drawing, finishing, fabricating and coating. Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.*

*** External Coatings Applied Outside of the United States¹³**

Any coating processes that are applied to the external surface of iron and steel components that would otherwise be AIS compliant would not disqualify the product from meeting the AIS requirements regardless of where the coating processes occur, provided that final assembly of the product occurs in the United States.

The exemption above only applies to coatings on the external surface of iron and steel components. It does not apply to coatings or linings on internal surfaces of iron and steel products, such as the lining of lined pipes. All manufacturing processes for lined pipes, including the application of pipe lining, must occur in the United States for the product to be compliant with AIS requirements.

(g) Municipal Castings¹⁴

Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings are: Access Hatches;

- Ballast Screen;
- Benches (Iron or Steel);
- Bollards;
- Cast Bases;
- Cast Iron Hinged Hatches, Square and Rectangular;

⁹ EPA guidance dated March 20, 2014, Question 14.

¹⁰ EPA guidance dated March 20, 2014, Question 15.

¹¹ EPA guidance dated March 20, 2014, Question 16.

¹² **Assembly and all other steps in the manufacturing process** must take place in the US, except metallurgical processes involving refinement of steel additives in accordance with the EPA guidance dated March 20, 2014, Question 23]. There is also an additional exception for application of exterior coating.

¹³ EPA guidance dated March 16, 2015, Q/A No. 6.

¹⁴ EPA guidance dated March 20, 2014, Question 19.

- Cast Iron Riser Rings;
- Catch Basin Inlet;
- Cleanout/Monument Boxes;
- Construction Covers and Frames;
- Curb and Corner Guards;
- Drainage Grates, Frames and Curb Inlets;
- Inlets;
- Junction Boxes;
- Lampposts;
- Manhole Covers, Rings and Frames, Risers;
- Meter Boxes;
- Service Boxes;
- Steel Hinged Hatches, Square and Rectangular;
- Steel Riser Rings;
- Trash receptacles;
- Tree Grates;
- Tree Guards;
- Trench Grates; and
- Valve Boxes, Covers and Risers.

(g) Municipal Castings (Cont.)

- Curb Openings;
- Detectable Warning Plates;
- Downspout Shoes (Boot, Inlet);

(h) Structural Steel¹⁵

Structural steel is rolled flanged shapes, having at least one dimension of their cross-section three inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zees. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

(i) Construction Materials¹⁶

Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered “structural steel”. This includes, but is not limited to, the following products: wire rod, bar, angles, concrete reinforcing bar, wire, wire cloth, wire rope and cables, tubing, framing, joists, trusses, fasteners (i.e., nuts and bolts), welding rods, decking, grating, railings, stairs, access ramps, fire escapes, ladders, wall panels, dome structures, roofing, ductwork, surface drains, cable hanging systems, manhole steps, fencing and fence tubing, guardrails, doors, and stationary screens.

[As noted above, ductwork is considered a “construction material” and must comply with the AIS requirements. Steel dampers, grilles and registers that are a permanently incorporated part of the ductwork are also subject to the AIS requirements.]

(j) Construction Materials (Additional Guidance¹⁷)

The AIS requirements include a list of specifically covered products, one of which is construction materials, a broad category of potential products. For construction materials, EPA’s AIS guidance includes a set of example items that it considers construction materials composed primarily of iron and steel and covered by the Act. This example list in the guidance is not an all-inclusive list of potential construction materials. However, the guidance also includes a list of items that EPA specifically does not consider construction materials, generally those of electrical or complex-mechanical nature. If a product is similar to the ones in the non-construction material list (and it is also not specifically listed by the Act), it is not a construction material. For all other items specifically included in the Act, coverage is generally self-evident.

(k) Items that are not Construction Materials¹⁸

¹⁵ EPA guidance dated March 20, 2014, Question 20.

¹⁶ EPA guidance dated March 20, 2014, Question 21.

¹⁷ EPA guidance dated September 10, 2014, Q/A No. 10.

¹⁸ EPA guidance dated March 20, 2014, Question 22.

Mechanical and electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples (including their appurtenances necessary for their intended use and operation) are NOT considered construction materials: pumps, motors, gear reducers, drives (including variable frequency drives (VFDs)), electric/pneumatic/manual accessories used to operate valves (such as electric valve actuators), mixers, gates (i.e., common sluice and slide gates), motorized screens (such as traveling screens), blowers/aeration equipment**, compressors, meters***), sensors, controls and switches, supervisory control and data acquisition (SCADA), membrane bioreactor systems, membrane filtration systems, filters, clarifiers and clarifier mechanisms, rakes, grinders, disinfection systems, presses (including belt presses), conveyors, cranes, HVAC (excluding ductwork), water heaters, heat exchangers, generators, cabinetry and housings (such as electrical boxes/enclosures), lighting fixtures, electrical conduit, emergency life systems, metal office furniture, shelving, laboratory equipment, analytical instrumentation, and dewatering equipment.*

** If products come from one manufacturer and are shipped together as a system, then this is generally considered a “packaged system” and those items used to connect the system are appurtenances. However, if the borrower or contractor must purchase items to connect the system (valves, piping, etc.) separately from another manufacturer, then these items would need to be domestic, or otherwise obtain a waiver.¹⁹*

***Aerators, similar to pumps, are mechanical equipment that do not need to meet the AIS requirements. “Blowers/aeration equipment, compressors” are listed in EPA’s guidance as non-construction materials.²⁰*

****“Meters” includes any type of meter, including: flow meters, wholesale meters, and water meters/service connections.²¹*

(l) Assembled Products²²

AIS requirements only apply to the final product as delivered to the work site and incorporated into the project. Assemblies, such as a pumping assembly or a reverse osmosis package plant, are distinct products not listed and do not need to be made in the U.S. or composed of all U.S. parts. If a listed iron and steel product is used as a part for an assembled product that is nondomestic, the components, even if specifically listed in the Act, do not have to be domestically produced.

(m) Sluice and Slide Gates are not Valves, and are not Subject to AIS²³

Valves are products that are generally encased / enclosed with a body, bonnet, and stem. Examples include enclosed butterfly, ball, globe, piston, check, wedge, and gate valves. Furthermore, “gates” (meaning sluice, slide or weir gates) are listed in EPA’s guidance as non-construction materials.

(n) Gate Valves are Subject to AIS²⁴

Valves are specifically listed in the Consolidated Appropriations Act of 2014 as an “iron and steel product” and therefore, absent a waiver, must be produced in the U.S. to be in compliance with the requirement if they are “primarily” iron and steel. Gates as referenced in the EPA March 20, 2014 guidance refer only to common sluice and slide gates, and not to gate valves.

¹⁹ EPA AIS Refresher Webinar, December 15, 2016.

²⁰ EPA guidance dated September 10, 2014, Q/A No. 19 on aerators.

²¹ EPA guidance dated September 10, 2014, Q/A No. 14 on meters.

²² EPA guidance dated September 10, 2014, Q/A No. 11, AIS Refresher Webinar, December 15, 2016.

²³ EPA guidance dated September 10, 2014, Q/A No. 20.

²⁴ EPA guidance dated May, 30, 2014, Q/A No. 4.

(o) Reinforced Precast Concrete²⁵

While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the reinforcing bar and wire must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin.

If the reinforced concrete is cast at the construction site, the reinforcing bar and wire are considered to be a construction material and must be produced in the US.

(p) Pre-stressed Concrete Cylinder Pipe²⁶

Pre-stressed concrete cylinder pipe (PCCP) or other similar concrete cylinder pipes would be comparable to pre-cast concrete which is specifically listed in the Consolidated Appropriations Act of 2014 as a product subject to the AIS requirement

(q) Valves and Actuators²⁷

Valves and actuators, while often purchased and shipped together, are two unique products that are manufactured separately and typically attached together during the final step of the process. Valves are included in the definition of "iron and steel products" in the AIS requirement. Actuators, whether manual, electric, hydraulic or pneumatic, are not listed as an "iron and steel product" under the AIS requirement of the Consolidated Appropriations Act of 2014, nor are they considered construction materials. Therefore, they do not need to be domestically produced in the U.S. in order to comply with the requirement.

(r) Electric Powered Motor Operated Valves²⁸

Electric powered motor operated valves are not excluded based on the valve being motorized equipment. The actuator, a motor that controls the valve, is considered a separate product, which is not listed as an "iron and steel product" under the AIS requirement of the Consolidated Appropriations Act of 2014, nor is it considered a construction material. Therefore, the actuator does not need to be domestically produced in the U.S. in order to comply with the requirement. See Q2 for further clarification.

(s) Tanks Used on Filtration Systems²⁹

Tanks that are specifically designed to be filters, or as parts of a filtration system, do not have to be domestically produced because these parts are no longer simply tanks, even if the filter media has not been installed and will be installed at the project site, as is customary to do for shipping purposes. These parts have only one purpose which is to be housing for filters and cannot be used in another fashion.

(t) Flanged Pipe³⁰

While the Consolidated Appropriations Act of 2014 does not specifically mention flanged pipe, since it does mention both pipe and flanges, both products would need to be domestically produced. Therefore, flanged pipe would also need to be domestically produced.

²⁵ EPA guidance dated March 20, 2014, Question 24.

²⁶ EPA guidance dated September 10, 2014, Q/A No. 2.

²⁷ EPA Q/A guidance dated May 30, 2014, Q/A No. 2.

²⁸ EPA guidance dated May 30, 2014, Q/A No. 3

²⁹ EPA guidance dated September 10, 2014, Q/A No. 4

³⁰ EPA guidance dated September 10, 2014, Q/A No. 5

(u) Couplings, Expansion Joints, and other Similar Pipe Connectors³¹

These products would be considered specialty fittings, due to their additional functionality, but still categorized under the larger “fitting” categorization. Fittings are defined as a material that joins pipes together or connects to a pipe (AWWA, The Drinking Water Dictionary, 2000). Therefore, these products must comply with the AIS requirements and be produced domestically.

(v) Saddles and tapping Sleeves³²

These products are necessary for pipe repair, to tap a water main, or to install a service or house connection. Therefore, they are included under the larger “pipe restraint” category which is a specifically identified product subject to the domestic preference in the Consolidated Appropriations Act of 2014.

(w) Reused Items (i.e., existing pipe fittings, used storage tanks, reusing existing valves)³³

The AIS guidance does not address reuse of items. Reuse of items that would otherwise be covered by AIS is acceptable provided that the item(s) was originally purchased prior to January 17, 2014, the reused item(s) is not substantially altered from original form/function, and any restoration work that may be required does not include the replacement or addition of foreign iron or steel replacement parts. EPA recommends keeping a log of these reused items by including them on the assistance recipient’s de minimis list, and stating therein that these items are reused products. The donation of new items (such as a manufacturer waiving cost for certain delivered items because of concerns regarding the origin of a new product) is not, however, considered reuse.

2. Certification

The Contractor, through its subcontractors, suppliers and manufacturers shall provide to the Owner written certification that all AIS materials provided for the project comply with the AIS requirements of the SRF programs, Manufacturer certification letters must include the following:

- Manufacturer name;
- SRF construction project name and location;
- A list of specific product(s) delivered to the project site;
- A statement that the product is in compliance with the American Iron and Steel requirement as mandated in EPA’s SRF programs;
- The location of the foundry/mill/factory where the product was manufactured (City and State); and
- A signature by a manufacturer’s responsible party.

EPA AIS guidance dated March 20, 2014 contains additional guidance on manufacturer certifications. [A sample certification letter is included in this guidance.](#)

3. Installation

All iron and steel products, as defined herein, shall be produced in the United States in accordance with the American Iron and Steel requirements of the Clean Water and Drinking Water State Revolving Fund programs. If a potentially non-compliant product is installed in the permanent work, the Contractor will be required to remove the non-domestic item from the project.

4. De Minimis Waiver

³¹ EPA guidance dated September 10, 2014, Q/A No. 6

³² EPA guidance dated September 10, 2014, Q/A No. 7

³³ EPA guidance dated September 10, 2014, Q/A No. 8

EPA's April 15, 2014 [Nationwide Waiver](#) for De Minimis incidental AIS components is part of this guidance, and is available for use on this project. Contractors who wish to use this waiver must consult with the Owner when determining the items to be covered by this waiver, and shall retain and provide to the Owner relevant documentation (i.e., invoices) for those items for the Owner's project files. The Contractor shall summarize in reports to the Owner: the types and/or categories of items to which this waiver is applied; the total cost of incidental components covered by the waiver for each type or category (including copies of invoices); and the calculations by which Contractor determined the total cost of materials used in and incorporated into the project. **The Contractor shall include a complete and up-to-date [De Minimis Report](#) in each application for payment.** The Contractor shall also provide the report to the Owner upon request.

(a) Fasteners under the De Minimis Waiver³⁴ []

There is no broad exemption for fasteners from the American Iron and Steel (AIS) requirements. Significant fasteners used in SRF projects are not subject to the de minimis waiver for projects and must comply with the AIS requirements. Significant fasteners include fasteners produced to industry standards (e.g., ASTM standards) and/or project specifications, special ordered or those of high value. When bulk purchase of unknown-origin fasteners that are of incidental use and small value are used on a project, they may fall under the national de minimis waiver for projects. The list of potential items could be varied, such as big-box/hardware-store-variety screws, nails, and staples. The key characteristics of the items that may qualify for the de minimis waiver would be items that are incidental to the project purpose (such as drywall screws) and not significant in value or purpose (such as common nails or brads). You can find further information on the [EPA Website](#).

³⁴ EPA guidance dated September 10, 2014, Q/A No. 1

American Iron and Steel Manufacturer Example Certification

Date

Manufacturer Name
Manufacturer Street Address
City, State ZIP

RE: Ledgeview Sewer Pump Station Upgrade

I, _____ (Authorized Manufacturer Representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

- _____
Item, Product and/or Materials
- _____
Item, Product and/or Materials
- _____
Item, Product and/or Materials
- _____
Item, Product and/or Materials
- _____
Item, Product and/or Materials

Manufacturing of the above items, products and/or materials took place at the following location(s):

Additionally, if any of the above compliance statements change while providing material to this project _____ (Manufacturer) will immediately notify _____ (Contractor) and the _____ (Owner).

Manufacturer's Signature

Note: The signature must be by manufacturer's authorized responsible party, not the material distributor or supplier.

Manufacturer Certification Checklist

- ✓ Manufacturer name;
- ✓ SRF construction project name and location;
- ✓ A list of specific product(s) delivered to the project site;
- ✓ A statement that the product is in compliance with the American Iron and Steel requirement as mandated in EPA's SRF programs;
- ✓ The location of the foundry/mill/factory where the product was manufactured (City and State); and
- ✓ A signature by a manufacturer's responsible party.

American Iron and Steel Required Subcontract and Purchase Agreement Language

The Contractor shall include in all contracts and purchase agreements for this project the following American Iron and Steel contract language:

“ _____ (Subcontractor/Supplier) acknowledges to and for the benefit of the _____ (Owner) and the State of New Hampshire (State) that it understands the goods and service under this contract or purchase agreement (Agreement) are being funded with monies that are subject to statutory requirements commonly known as “American Iron and Steel” (the Water Resources Reform and Development Act of 2014, the Consolidated Appropriations Act of 2014 ([Public Law 113-76](#)), and subsequent laws that continue the requirement for the use of American Iron and Steel products in State Revolving Fund construction projects); that requires all of the iron and steel products used in the project to be produced in the United States (“American Iron and Steel Requirement”) including iron and steel products provided under this contract or Agreement. The Subcontractor/Supplier hereby represents and warrants to and for the benefit of the Owner and the State that (a) the Subcontractor/Supplier has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Subcontractor/Supplier will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Owner or the State.”

NHDES-W-09-060



**BIDDERS AMERICAN IRON AND STEEL
ACKNOWLEDGEMENT**
NHDES CLEAN WATER AND DRINKING WATER
STATE REVOLVING FUND



Public Law 113-76

Instructions: This acknowledgement form must be completed and signed by the bidder's authorized representative, and conveyed to owner with bid submittal. You will find NHDES bid information in [Section A](#) of the front-end documents.

Project Name: Ledgeview Sewer Pump Station Upgrade

City/ Town/ Entity: City of Rochester, New Hampshire

Bidder Name _____

Bidder Address _____

With submittal of this Bid, the Bidder acknowledges to and for the benefit of the Owner and the State of New Hampshire (State) that it understands that this project is subject to the "[American Iron and Steel \(AIS\)](#)" requirements of the Water Resources Reform and Development Act of 2014, the Consolidated Appropriations Act of 2014 ([Public Law 113-76](#)), and subsequent laws that continue the requirement for the use of American Iron and Steel products in State Revolving Fund construction projects, and these laws require that all of the iron and steel used in the project be produced in the United States ("American Iron and Steel Requirement") including all iron and steel goods provided by the Bidder pursuant to this Bid.

The Bidder hereby presents and warrants to and for the benefit of the Owner and State that (a) the Bidder has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Bidder will provide any further verified information, certification or assurance of compliance with this Acknowledgement, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Owner or the State

Notwithstanding any other provision of the Contract Documents, any failure to comply with this Acknowledgement by the Bidder shall permit the Owner or State to recover as damages against the Bidder any loss, expense, or cost (including without limitation attorney's fees) incurred by the Owner or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Owner).

Additionally, The Bidder hereby acknowledges that Bidder must include in all contracts and purchase agreements for this project the following American Iron and Steel contract language:

"(Subcontractor/Supplier) acknowledges to and for the benefit of the City of Rochester and the State of New Hampshire (State) that it understands the goods and service under this contract or purchase agreement (Agreement) are being funded with monies that are subject to statutory requirements commonly known as "American Iron and Steel" (the Water Resources Reform and Development Act of 2014, the Consolidated Appropriations Act of 2014 ([Public Law 113-76](#)), and subsequent laws that continue the requirement for the use of American Iron and Steel products in State Revolving Fund construction projects); that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided under this contract or Agreement. The Subcontractor/Supplier hereby represents and warrants to and for the benefit of the Owner and the State that (a) the Subcontractor/Supplier has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Subcontractor/Supplier will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Owner or the State.

(Signature of Certifying Bidder Representative)

Date

Printed Name

AIS EPA De Minimis Waiver



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER

DECISION MEMORANDUM

SUBJECT: De Minimis Waiver of Section 436 of P.L. 113-76, Consolidated Appropriations Act (CAA), 2014

FROM: Nancy K. Stoner
Acting Assistant Administrator

The EPA is hereby granting a nationwide waiver pursuant to the “American Iron and Steel (AIS)” requirements of P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), section 436 under the authority of Section 436(b)(1) (public interest waiver) for de minimis incidental components of eligible water infrastructure projects. This action permits the use of products when they occur in de minimis incidental components of such projects funded by the Act that may otherwise be prohibited under section 436(a). Funds used for such de minimis incidental components cumulatively may comprise no more than a total of 5 percent of the total cost of the materials used in and incorporated into a project; the cost of an individual item may not exceed 1 percent of the total cost of the materials used in and incorporated into a project.

P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel” (AIS) requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use specific domestic iron and steel products that are produced in the United States if the project is funded through an assistance agreement executed beginning January 17, 2014 (enactment of the Act), through the end of Fiscal Year 2014, unless the agency determines it necessary to waive this requirement based on findings set forth in Section 436(b). The Act states, “[the requirements] shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency...finds that— (1) applying subsection (a) would be inconsistent with the public interest” 436(b)(1).

In implementing section 436 of the Act, the EPA must ensure that the section's requirements are applied consistent with congressional intent in adopting this section and in the broader context of the purposes, objectives, and other provisions applicable to projects funded under the SRF. Water infrastructure projects typically contain a relatively small number of high-cost components incorporated into the project. In bid solicitations for a project, these high-cost components are generally described in detail via project specific technical specifications. For these major components, utility owners and their contractors are generally familiar with the conditions of availability, the potential alternatives for each detailed specification, the approximate cost, and the country of manufacture of the available components.

Every water infrastructure project also involves the use of thousands of miscellaneous, generally low-cost components that are essential for, but incidental to, the construction and are incorporated into the physical structure of the project. For many of these incidental components, the country of manufacture and the availability of alternatives is not always readily or reasonably identifiable prior to procurement in the normal course of business; for other incidental components, the country of manufacture may be known but the miscellaneous character in conjunction with the low cost, individually and (in total) as typically procured in bulk, mark them as properly incidental. Examples of incidental components could include small washers, screws, fasteners (i.e., nuts and bolts), miscellaneous wire, corner bead, ancillary tube, etc. Examples of items that are clearly not incidental include significant process fittings (i.e., tees, elbows, flanges, and brackets), distribution system fittings and valves, force main valves, pipes for sewer collection and/or water distribution, treatment and storage tanks, large structural support structures, etc.

The EPA undertook multiple inquiries to identify the approximate scope of de minimis incidental components within water infrastructure projects during the implementation of the American Reinvestment and Recovery Act (ARRA) and its requirements (Buy American provisions, specifically). The inquiries and research conducted in 2009 applies suitably for the case today. In 2009, the EPA consulted informally with many major associations representing equipment manufacturers and suppliers, construction contractors, consulting engineers, and water and wastewater utilities, and performed targeted interviews with several well-established water infrastructure contractors and firms who work in a variety of project sizes, and regional and demographic settings to ask the following questions:

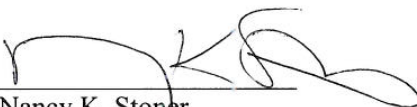
- What percentage of total project costs were consumables or incidental costs?
- What percentage of materials costs were consumables or incidental costs?
- Did these percentages vary by type of project (drinking water vs. wastewater treatment plant vs. pipe)?

The responses were consistent across the variety of settings and project types, and indicated that the percentage of total costs for drinking water or wastewater infrastructure projects represented by these incidental components is generally not in excess of 5 percent of the total cost of the materials used in and incorporated into a project. In drafting this waiver, the EPA has considered the de minimis proportion of project costs generally represented by each individual type of these incidental components within the many types of such components comprising those percentages, the fact that these types of incidental components are obtained by contractors in many different ways from many different sources, and the disproportionate cost and delay that would be imposed on projects if the EPA did not issue this waiver.

Assistance recipients who wish to use this waiver should in consultation with their contractors determine the items to be covered by this waiver and must retain relevant documentation (i.e., invoices) as to those items in their project files.

If you have any questions concerning the contents of this memorandum, please contact Timothy Connor, Chemical Engineer, Municipal Support Division, at connor.timothy@epa.gov or (202) 566-1059 or Kirsten Anderer, Environmental Engineer, Drinking Water Protection Division, at anderer.kirsten@epa.gov or (202) 564-3134.

Issued on: APR 15 2014

Approved by: 
Nancy K. Stoner
Acting Assistant Administrator

NHDES-W-09-048-1



AMERICAN IRON AND STEEL DE MINIMIS TRACKING REPORT

NHDES CLEAN WATER AND DRINKING WATER STATE REVOLVING FUND



(To be submitted with each application for payment.)

Public Law 113-76 Consolidated Appropriations Act

De Minimis Waiver Section 436

Contractors who wish to use the AIS De Minimis waiver must consult with the owner when determining the items to be covered by this waiver, and shall retain and provide to the owner relevant documentation (i.e., invoices) for those items. The contractor shall summarize in reports to the owner the types and/or categories of items to which this waiver is applied; the total cost of incidental components covered by the waiver for each type or category (including copies of invoices); and the calculations by which contractor determined the total cost of materials used in and incorporated into the project. **The contractor shall include a complete and up-to-date De Minimis Tracking Report in each application for payment.** The contractor shall also provide the report to the owner upon request.

Owner: City of Rochester, New Hampshire		Project Name: Ledgerview Sewer Pump Station Upgrade				
Contractor:		CWSRF/DWSRF Project #: CS-334122-21				
Has the contractor purchased or used AIS materials that will be covered under this waiver?						
<input type="checkbox"/> Yes. Please continue to the next section. <input type="checkbox"/> No. Please simply sign below.						
Total cost of materials incorporated into the project.		De Minimis 5% Limit		De Minimis 1% Limit		
<input type="checkbox"/> Yes <input type="checkbox"/> No	Is this your final report? In order to be considered a final report all materials have been delivered for the project.					
Component Description	Date Added	County of Origin (if available)	Quantity (if applicable)	Cost Per Unit (if applicable)	Component Total Cost	How is cost documented ³⁵ ?
Total Cost of De Minimis Components						

Contractor Signature:		Printed Name:	
Title:		Date:	

NOTE: The De Minimis waiver is only applicable to the cost of materials incorporated into the project. Do not include other project costs (labor, installation costs, etc.) in the "Total Cost of Materials." The cost of a material must include delivery to the site and any applicable tax. Contractor must provide sufficient documentation to support all costs included in this calculation.

³⁵ Documentation must demonstrate confirmation of the components' actual costs (invoice etc.).

NH Department of Environmental Services Federal Labor Standards Provisions

29 CFR 5.5(a)

Contract and Subcontract provisions

(a) The Contractor shall insure that all sub contracts entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF - financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or -FY 2015 Water Resource Reform and Development Act, contain the following clauses:

(1) Minimum Wage (i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers. Wage determinations may be obtained from the [U.S. Department of Labor's website](#).

(ii)(A) The Loan recipient, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Loan recipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the Loan recipient(s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department

of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the Loan Recipient (s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside, in a separate account, assets for the meeting of obligations under the plan or program.

(2) Withholding. The Loan recipient(s), shall upon written request of the Contracting Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records. (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain

written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the Loan recipient, that is, the entity that receives the sub-grant or Loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the Loan recipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the Loan recipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the Loan recipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the

suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Loan recipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

10) Certification of eligibility. (i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

4. Contract Provision for Contracts in Excess of \$100,000 (a) Contract Work Hours and Safety Standards Act. The Loan recipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

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

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

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

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

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Prime Contractor shall insert a clause requiring that the subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Prime Contractor shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the subcontractor for inspection, copying, or transcription by authorized representatives of NH DES and the Department of Labor, and the subcontractor will permit such representatives to interview employees during working hours on the job.

"General Decision Number: NH20240023 03/22/2024

Superseded General Decision Number: NH20230023

State: New Hampshire

Construction Type: Building

County: Strafford County in New Hampshire.

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

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	<ul style="list-style-type: none">. Executive Order 14026 generally applies to the contract.. The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	<ul style="list-style-type: none">. Executive Order 13658 generally applies to the contract.. The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/05/2024
1	03/22/2024

ASBE0006-014 09/01/2023

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR.....	\$ 42.80	35.16

BOIL0029-005 01/01/2021

	Rates	Fringes
BOILERMAKER.....	\$ 38.08	25.70

BRNH0003-001 06/01/2020

	Rates	Fringes
BRICKLAYER.....	\$ 42.55	28.02

* ELEC0490-006 01/01/2024

	Rates	Fringes
ELECTRICIAN (Includes Low Voltage Wiring and Alarm Installation).....	\$ 34.49	22.49

ELEV0004-007 01/01/2023

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 68.38	37.335+a+b

- a. PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, Christmas Day and the Friday after Thanksgiving.
- b. VACATION: Employer contributes 8% of basic hourly rate for 5 years or more of service; 6% of basic hourly rate for 6 months to 5 years of service as vacation pay credit.

IRON0007-038 09/16/2023

	Rates	Fringes
IRONWORKER, REINFORCING.....	\$ 30.83	24.97

PLUM0131-004 06/05/2023

	Rates	Fringes
PIPEFITTER.....	\$ 40.36	25.24

* SUNH2015-009 06/16/2017

	Rates	Fringes
CARPENTER, Includes Acoustical Ceiling Installation, Drywall Hanging, Form Work, and Metal Stud Installation.....	\$ 26.14	12.05

CEMENT MASON/CONCRETE FINISHER...\$ 22.04	9.70
DRYWALL FINISHER/TAPER.....\$ 24.80	0.00
GLAZIER.....\$ 26.75	3.48
IRONWORKER, STRUCTURAL.....\$ 24.16	12.42
LABORER: Common or General.....\$ 17.92	12.72
LABORER: Mason Tender - Brick...\$ 16.52 **	4.74
OPERATOR: Backhoe/Excavator/Trackhoe.....\$ 24.02	4.25
OPERATOR: Crane.....\$ 27.42	3.83
OPERATOR: Loader.....\$ 22.25	2.13
OPERATOR: Roller.....\$ 23.56	3.28
PAINTER (Brush and Roller).....\$ 17.13 **	0.00
PAINTER: Spray.....\$ 22.99	3.28
PLUMBER, Includes HVAC Pipe Installation.....\$ 24.60	9.40
ROOFER.....\$ 19.55	0.00
SHEET METAL WORKER, Includes HVAC Duct Installation.....\$ 24.88	5.46
SPRINKLER FITTER (Fire Sprinklers).....\$ 31.29	9.78
WATERPROOFER.....\$ 26.69	0.00

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

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 ** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.20) or 13658 (\$12.90). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons

resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

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

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

Union Rate Identifiers

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

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

Survey Rate Identifiers

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

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

Union Average Rate Identifiers

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

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

WAGE DETERMINATION APPEALS PROCESS

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

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

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

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

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

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

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

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

3.) If the decision of the Administrator is not favorable, an

interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

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

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

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END OF GENERAL DECISION"

CITY OF ROCHESTER
INSTRUCTION TO BIDDERS

- I. PREPARATION OF BID PROPOSAL**
- II. IRREGULAR PROPOSALS**
- III. DELIVERY OF PROPOSALS**
- IV. ELECTRONIC BID FORMAT**
- V. WITHDRAWAL OF BID PROPOSAL**
- VI. PUBLIC OPENING OF BID PROPOSAL**
- VII. DISQUALIFICATION OF BIDDERS**
- VIII. CONSIDERATION OF PROPOSALS**
- IX. AWARD OF CONTRACT**
- X. CANCELLATION OF AWARD**
- XI. BID EVALUTAION**
- XII. LAWS, PERMITS & REGULATIONS**
- XIII. INSURANCE & LEGAL BUSINESS ENTITY**
- XIV. DEFAULT & TERMINATION OF CONTRACT**
- XV. OPENING BID RESULTS**
- XVI. DIFFERING REQUIREMENTS**

I. PREPARATION OF BID PROPOSAL

1. The Bidder shall submit her/his proposal upon the form(s) furnished in Section A . The bidder shall specify a unit price or lump sum for each pay item. All figures shall be in ink or typed.
2. If a unit price or lump sum bid already entered by the bidder on the proposal form is to be altered it should be crossed out with ink, the new unit price or lump sum bid entered above or below it, and initialed by the bidder, also with ink. In case of discrepancy between the prices written in words and those written in figures, the prices written in words shall govern.
3. The bidder's proposal must be signed with ink by an individual authorized by company to execute the proposal. Required information shall be name of authorized individual, title of individual, legal business name, address, email, and telephone number.
4. All questions shall be submitted in writing to and received by the Purchasing Agent at the address provided in the Advertisement, a minimum of 7 days prior to the scheduled bid opening. The Purchasing Agent, will then forward both the question and the city's response to the question to all known prospective bidders.

II. IRREGULAR PROPOSALS

Bid proposals will be considered irregular and may be rejected for any of the following reasons:

1. If the proposal is on a form other than that furnished by the Owner or if the form is altered or any part thereof is detached.
2. If there are unauthorized additions, conditional or alternate bids, or irregularities of any kind which may tend to make the proposal incomplete, indefinite or ambiguous as to its meaning.
3. If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.
4. If the proposal does not contain a unit price or lump sum for each pay item listed, except in the case of authorized alternate pay items.

III. DELIVERY OF BID PROPOSALS

When sent by mail, the sealed proposal shall be addressed to the City of Rochester, Purchasing Agent, 31 Wakefield Street, Rochester, NH 03867. All proposals shall be filed prior to the time and at the place specified in the Advertisement for Bids. Proposals received after the time for opening of the bids will be returned to the bidder, unopened. Emailed bid proposals to any other address than RFP24-39@rochesternhnet.onmicrosoft.com or faxed bid proposals are not acceptable.

IV. ELECTRONIC BIDS: Due to Covid-19 the City of Rochester has incorporated an electronic bid process. If an electronic format is to be utilized specific submission instructions will be identified in the bid cover page.

V. WITHDRAWAL OF BID PROPOSALS

A bidder will be permitted to withdraw his proposal unopened after it has been deposited if such request is received in writing prior to the time specified for opening the proposals.

VI. PUBLIC OPENING OF BID PROPOSALS

Proposals will be opened and read publicly at the time and place indicated in the Advertisement for Bids. Bidders, their authorized agents, and other interested parties are invited to be present.

VII. DISQUALIFICATION OF BIDDERS

Either of the following reasons may be considered as being sufficient for the disqualification of a bidder and the rejection of her/his bid proposal(s):

1. Evidence of collusion among bidders.
2. Failure to supply complete information as requested by the bid specifications.

VIII. CONSIDERATION OF PROPOSALS

1. Bids will be made public at the time of opening and may be reviewed only after they have been properly recorded. In case of discrepancy between the prices written in words and those written figures, the prices written in words shall govern. In case of a discrepancy between the total shown in the proposal and that obtained by adding the products of the quantities of items and unit bid prices, the latter shall govern.
2. The right is reserved to reject any or all proposals, to waive technicalities or to advertise for new proposals, if in the judgment of the City, the best interest of the City of Rochester will be promoted thereby.
3. Bid results will be available on the website at <https://www.rochesternh.gov/bids> within 48 hours of the bid opening.

IX. AWARD OF CONTRACT

The City holds the right, in its judgment, to award the contract to the bidder, which it feels is in the best interest of the City. If a contract is to be awarded, the Contractor/Vendor selection shall be based in part on possession of the necessary experience, organization, technical and professional qualifications, skills and facilities, reference checks, project understanding, approach, ability to comply with proposed or required time to completion or performance, licensing or certification, in good standing with Federal, State and Local agencies, possession of satisfactory record of performance, cost and to a responsible and qualified bidder whose proposal complies with all the requirements prescribed as soon as practical after the bid opening. No bid shall be withdrawn for a period of (75) seventy-five days subsequent to the opening of bids without the consent of the City of Rochester. The successful bidder will be notified, by the form mailed to the address on his proposal, that his bid has been accepted and that he has been awarded the contract.

X. CANCELLATION OF AWARD

The City reserves the right to cancel the award of any contract at any time before the execution of such contract by all parties without any liability or other claim against the City.

XI. BID EVALUATION

In addition to the bid amount, additional factors will be considered as an integral part of the bid evaluation process, including, but not limited to:

1. The bidder's ability, capacity, and skill to perform within the specified time limits.
2. The bidder's experience, reputation, efficiency, judgment, and integrity.
3. The quality, availability and adaptability of the supplies and materials sold.
4. The bidder's past performance.
5. The sufficiency of bidder's financial resources to fulfill the contract.
6. The bidder's ability to provide future maintenance and/or services.
7. Any other applicable factors as the City determines necessary and appropriate (such as compatibility with existing equipment).

XII. LAWS, PERMITS AND REGULATIONS

1. The Contractor shall obtain and pay for all licenses and permits as may be required of him by law, and shall pay for all fees and charges for connection to outside services, and use of property other than the site of the work for storage of materials or other purposes.
2. The Contractor shall comply with all State and Local laws, ordinances, regulations and requirements applicable to work hereunder, including building code requirements. If the Contractor ascertains at any time that any requirement of this Contract is at variance with applicable laws, ordinances, regulations or building code requirements, she/he shall promptly notify the City of Rochester in writing.

XIII. INSURANCE & LEGAL BUSINESS ENTITY

1. Contractor and any related subcontractors will carry appropriate liability insurance, and be a legal business entity authorized to conduct business in the State of New Hampshire.

XIV. DEFAULT AND TERMINATION OF CONTRACT**If the Contractor:**

1. Fails to begin work under Contract within the time specified in the notice to proceed; or
2. Fails to perform the work with sufficient workers and equipment, or with sufficient materials to assume prompt completion of said work; or
3. Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable; or
4. Discontinues the prosecution of the work; or
5. Fails to resume work, which has been discontinued, within the time frames included in specifications; or

6. Becomes insolvent or has declared bankruptcy, or commits any act of bankruptcy or insolvency; or
7. Makes an assignment for the benefit of creditors; or
8. For any other causes whatsoever, fails to carry on the work in an acceptable manner the City of Rochester will give notice, in writing, to the Contractor for such delay, neglect, and default.

If the Contractor does not proceed in accordance with the Notice, then the City of Rochester will have full power and authority without violating the Contract to take the prosecution of the work out of the hands of the Contractor. The City of Rochester may enter into an agreement for the completion of said Contract according to the terms and conditions thereof, or use such other methods as in the City's opinion will be required for the completion of said Contract in an acceptable manner.

All extra costs and charges incurred by the City of Rochester as a result of such delay, neglect or default, together with the cost of completing the work under the Contract will be deducted from any monies due or which may become due to said Contractor. If such expenses exceed the sum which would have been payable under the contract, then the Contractor shall be liable and shall pay to the City of Rochester the amount of such excess.

XV. OBTAINING BID RESULTS

Bid results will be available on the website at <https://www.rochesternh.gov/bids> within 48 hours of the bid opening.

XVI. DIFFERING REQUIREMENTS

Where requirements differ, the stricter requirement shall be enforced.

SECTION 00 31 32

SUBSURFACE DATA

PART I - GENERAL

1.01 SCOPE:

- A. A subsurface exploration program consisting of soil borings, has been performed, with reasonable care. The following geotechnical report is appended hereto and is for informational purposes as described below:

“Geotechnical Engineering Report, Ledgeview Drive Pump Station, Rochester, New Hampshire” dated March 5, 2024.

- B. The attached subsurface data is provided for informational purposes only. The Contractor shall not rely on the interpretations, opinions, conclusions, or recommendations included in the report, only the factual data relative to the specific times, locations, and depths/elevations. Specific project requirements are referenced only in the drawings and specifications.
- C. If Contractors deem the subsurface information insufficient, they may, after obtaining Owner’s permission, carry out additional subsurface explorations, at no expense to the Owner.
- D. Subsurface information provided in the Contract Documents is limited by the methods used for obtaining and expressing such data and is subject to various interpretations. The terms used to describe soils, rock, groundwater, and such other conditions are subject to local usage and individual interpretation.
- E. Borings and test pits have been completed substantially at the locations indicated on the drawings and advanced to the depths shown on the logs. Soil information presented in the boring logs, as to classification, gradation, properties, density and consistency, is based on visual observation of recovered samples. Reported groundwater levels are those measured in the field at the particular location and at the time measurements were made, and do not necessarily represent permanent or seasonal groundwater elevations. Groundwater elevations may be affected by temperature, rainfall, tidal fluctuation, and other factors that may not have been present at the time the measurements were made. The Contractors should be aware that groundwater level fluctuations may affect methods of construction.
- F. Subsurface exploration, soil and rock data are for the general information of the Contractors. The Contractors are obligated to examine the site, review boring and test pit logs, all available information and records of explorations, investigations and other pertinent data for the site, and then based upon their own interpretations and investigations decide the character of material to be encountered and excavated, the suitability of the materials to be used for backfilling and such other purposes, the groundwater conditions, difficulties or obstacles likely to be encountered, and other

conditions affecting the work. The subsurface data is accurate only at the particular locations and times the subsurface explorations were made. No other warranty either expressed or implied by the Owner, Engineer or their agents is made as to the accuracy of the subsurface information and data shown on the drawings or presented in the Contract Documents.

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

Not used.

END OF SECTION

Document19

March 5, 2024

City of Rochester, New Hampshire
c/o John Sykora III
Weston & Sampson Engineers, Inc.
100 International Drive, Suite 152
Portsmouth, NH 03801

**Re: Geotechnical Engineering Report
Ledgeview Drive Pump Station
Rochester, NH**

INTRODUCTION

Weston & Sampson Engineers, Inc. (Weston & Sampson) is pleased to present this report for the proposed Ledgeview Drive Sewer Pump Station Improvements project in Rochester, New Hampshire. This geotechnical engineering report presents the results of subsurface explorations and provides geotechnical recommendations for the project.

We have prepared this report for use by the City of Rochester and the design and construction teams for this project for this site only. For important information on the use of this report, please refer to the *Limitations* section of this report, and the document “Important Information about this Geotechnical Engineering Report” by the Geoprofessional Business Association (GBA), Inc., included as *Attachment C*.

EXISTING SITE CONDITIONS AND PROPOSED IMPROVEMENTS

The existing sewer pump station is located at Lot 10 on Ledgeview Drive as shown in *Figure 1 – Site Locus*. The facility was constructed around 1985 and includes a pumping station with an above-grade fiberglass reinforced plastic enclosure, a concrete wet well which extends to a depth of about 17 feet below the ground surface, a weather-enclosed generator, above-grade propane storage tank, concrete equipment pads, and associated piping and electric lines. Existing ground surface is at approximately elevation (El.) 204.5 at the pump station and slopes up to approximately El. 208 at Ledgeview Drive to the west. Grades rise slightly to the north, south, and east before sloping downward to approximately El. 202 within wetlands bordering the pump station to the north, south, and east. Elevations given in this report are in feet and reference the North American Vertical Datum of 1988 (NAVD 88).

Based on 90% design drawings prepared by Weston & Sampson, the proposed project includes replacement of the existing fiberglass enclosure with an approximately 16-foot by 16-foot single story timber building with a concrete floor slab, which will house new suction lift pumps and associated equipment. The building will span over the existing wet well which is to remain in place. A new generator and generator pad is proposed northeast of the proposed building. Selected drawing

sheets from the 90% Draft Design Set by Weston & Sampson, dated March 1, 2024, are included in *Attachment A*.

Based on preliminary structural information, we anticipate that the proposed building will have foundation loads of approximately 4.5 kips per linear foot. We understand that ground surface at and around the proposed building will be raised by approximately 1 to 2 feet above existing grades to improve surface drainage conditions.

EXISTING SUBSURFACE INFORMATION

Geologic Setting

Based on information available from the United States Geological Survey (USGS) and shown on the Surficial Geologic Map of Parts of the Rochester and Somersworth Quadrangles, Strafford County, New Hampshire (Koteff, 1991), soils at the site include sand, silt, and clay of the Presumpscot Formation. Based on the Bedrock Geologic Map of New Hampshire (Lyons et. al., 1997), bedrock at the site is part of the Berwick Formation, consisting of biotite-quartz feldspar granofels or schist, and interbeds of calc-silicate granofels and minor metapelites. Shallow bedrock is mapped to the west of the site.

Subsurface Explorations

Weston & Sampson explored subsurface conditions for the proposed new building by advancing two test borings (B-1 and B-2) on April 5, 2023 at the approximate locations shown on *Figure 2 – Site Plan*. The borings were completed by New England Boring Contractors of Derry, NH using an ATV-mounted drill rig and wash rotary drilling methods. Standard penetration tests (SPTs) were conducted in each boring by driving a split spoon sampler with an automatic hammer in general accordance with ASTM with ASTM D1586.

Weston & Sampson geotechnical engineering representatives observed drilling activities in the field and prepared logs for each boring. Subsurface conditions encountered in the borings are described in the following sections and in the boring logs included in *Attachment B*.

Subsurface Conditions

The subsurface conditions encountered in our explorations are described in the following sections in general order of increasing depth. The general Unified Soil Classification System (USCS) designation for each stratum is included in the descriptions below in parentheses.

Subsurface conditions described below have been interpreted based on a limited number of borings that were observed by Weston & Sampson. Variations may occur and should be expected between locations. The strata boundaries shown in our logs are based on our interpretations and the actual transitions may be gradual. Refer to the boring logs for detailed descriptions of the soil samples collected.

Surface Conditions – Boring B-1 encountered bare soil at the ground surface, and B-2 encountered grass overlying approximately 3 inches of topsoil.

Fill – Medium dense fill was encountered at the ground surface in B-1 and below the topsoil in B-2 and extended to approximate depths of 2.5 feet in both borings. The fill generally consisted of SAND with little to some gravel and trace silt (SP or SW).

Silty Sand / Sandy Silt – Native silty sand and sandy silt was encountered below the fill and consisted of either medium stiff SILT with little sand and little gravel (ML) or medium dense SAND with some silt and trace to little gravel (SM). Trace to occasional roots and plant fibers were noted to a depth of approximately 6 feet. This stratum extended to a depth of approximately 8.5 feet in both borings.

Clay– Lean CLAY with trace to little sand and up to little gravel (CL) was encountered below the Silty Sand/Sandy Silt. The clay was generally medium stiff within the upper approximately 5 feet, becoming soft to very soft at greater depths. An approximately 2.5-foot-thick layer of sandy silt with gravel (ML) was encountered within the clay in boring B-1. B-1 terminated within the clay at a depth of approximately 21 feet. The clay extended to a depth of 40.2 feet in B-2.

Refusal – Boring B-2 encountered drilling refusal (defined as no discernible advancement of the drill bit over a period of 5 minutes) at a depth of 40.5 feet. Rock coring was not performed; therefore the refusal may have been on a boulder or on bedrock.

Groundwater - Groundwater was measured at a depth of approximately 4.3 feet in boring B-1, approximately 3 hours after drilling. Given the introduction of water into the borehole during drilling, this may not represent a stabilized groundwater level. Depth to groundwater was not measured in B-2. We anticipate that groundwater levels will fluctuate with season, variations in precipitation, construction in the area, and other factors. Perched groundwater conditions could exist close to the ground surface, especially during and after extended periods of wet weather.

GEOTECHNICAL DESIGN RECOMMENDATIONS

General

The subsurface conditions generally consist of fill overlying silty sand / sandy silt and clay extending to probable bedrock. The fill extended to about 2.5 feet in our borings but is anticipated to extend to the bottom of the wet well close to the structure. The existing fill is not suitable to support the proposed structures and the clay is susceptible to significant settlement due to increases loads from the structures and proposed fill.

Therefore, we recommend supporting the pump station building and equipment on a structural slab supported by deep foundations extending to suitable bearing strata below the fill, native silty sand/sandy silt, and clay. Grade increases around the building and above existing utilities should be constructed using lightweight fill following over-excavation of the existing soils to impart little to

no net load increase on the underlying compressible soils. The generator pad may be constructed as a mat foundation bearing within the native sands, provided the generator is designed to tolerate anticipated settlement as discussed below; alternatively, the generator could be supported on deep foundations.

Geotechnical design and construction recommendations are provided in the following sections. The following recommendations are based on our project understanding and assumptions as described above. If changes are made to proposed locations, grades, structure types, depths, and project approach, the following conclusions and recommendations may not be applicable. If design changes are made, we should be retained to review our conclusions and recommendations and provide a written evaluation or modification.

Deep Foundations

General

Based on the subsurface conditions encountered in our explorations and preliminary structural loads, the proposed pump station building should be supported on deep foundations extending through the clay and bearing on rock. We considered various pile types including driven end-bearing piles, helical piles, Stelcor drilled displacement piles, and drilled micropiles (DMPs).

- Driven piles are not recommended due to the proximity to the existing wet well and the risk of structural damage from construction vibrations.
- Helical piles typically extend to about 10 to 25 feet and would therefore bear within or just above the very soft clay. Helical piles are not recommended due to the corresponding low capacity and high estimated settlement.
- Stelcor drilled displacement piles develop their capacity through side friction and would therefore have low capacity. Additionally, the soil displacement during installation would increase the lateral pressures on the existing wet well which is not desirable.

Drilled micropiles (DMPs) are therefore recommended, as they are installed using non-vibratory, cased drilling methods and can be drilled to derive their capacity within the bedrock underlying the soft clay at the site.

DMPs are small diameter piles, typically 6-inches to 12-inches, with grouted pipe pile casing in its upper zone, steel rebar at the center, and a grouted annulus in its bond zone. DMP lengths should be designed based on final design loads (including axial, lateral, and uplift loads). Based on the anticipated pile loads, we recommend DMPs be designed to derive their support entirely by side resistance within bedrock, which is anticipated to be approximately 40 feet below existing grade. End bearing resistance should be ignored.

DMP Geotechnical Capacity

Assuming a gravity grouted (Type 1) DMP, the required embedment may be estimated using the values shown in *Table 1*. DMPs should extend a minimum of 5 feet into bedrock, or deeper as needed to develop the required load capacity.

Table 1: Recommended DMP Skin Friction

DMP Diameter (in)	Allowable Capacity in Rock (kips/ft bonded length)
6.625	3.7
9.625	5.4
12	6.8

Notes:

- (1) Allowable Capacity assumes a Factor of Safety of 2.0 per Chapter 5 of "FHWA NHI-05-039 for Micropile Design" and use an ultimate grout-to-ground bond strength of 30 psi for bedrock.
- (2) Skin friction values are equivalent in compression and uplift.

The final design of the drilled micropile bond length should be confirmed by the specialty drilled micropile contractor engaged by the Contractor who is experienced in design, construction, and testing of DMPs in similar subsurface conditions anticipated for this project. DMPs should be designed in accordance with the latest edition of the New Hampshire Building Code. The DMP design should be stamped by a Professional Engineer licensed in the State of New Hampshire and include calculations that demonstrate adequate vertical and lateral geotechnical and structural capacities. A minimum factor of safety of 2.0 should be used to calculate the allowable geotechnical resistance based on the results of successful verification load testing. Weston & Sampson should be contacted for full-time observation of DMP installation and to evaluate minimum embedment depths and allowable capacities.

Pile Caps, Pile Spacing, and Resistance to Lateral Loads

Use of DMPs will require pile caps and/or grade beams for support of the building and slab loads. The bottoms of pile caps and grade beams should be located at least 4 feet below lowest adjacent ground surface exposed to freezing or be supported over non-frost susceptible material to at least 4 feet below final grades. The minimum center to center spacing of piles should be at least 3 times the pile diameter.

Table 2, below, provides recommended soil parameters for lateral pile analysis using computer software such as LPILE by Ensoft or RSPile by RocScience. The lateral deflection analysis should include the effects of group interaction.

Table 2: Lateral Load Analysis Design Parameters

Stratum	Total Unit Weight (pcf)	Friction Angle	Reaction Modulus, k (pci)	Undrained Strength, Su (psf)	Strain Factor, ϵ_{50}
Existing Fill and Native Sand/Silt	120	33°	60	--	--
Clay	115	--	--	1000 (med stiff to stiff) 400 (very soft to soft)	0.01 (med stiff to stiff) 0.02 (very soft to soft)
Rock	135	40°	150	--	--

Pile Load Testing

A pile load test program should be performed during construction to confirm pile capacities. A verification test should be conducted prior to construction on a sacrificial pile that is not used in the final structure.

Generator Pad

The generator pad may be constructed as a mat foundation bearing on the native sand or engineered fill placed above the native silty sand / sandy silt following removal of the topsoil and existing fill. We performed analysis to estimate long-term settlement of the generator pad based on encountered soil conditions and loading information provided by the Structural Engineer. Based on our evaluation, slab loads of up to 500 psf are anticipated to induce approximately 1.5 inches of settlement. If this settlement is greater than the slab and utility connections tolerances, we recommend supporting the generator pad on a structural slab supported by DMP as describe above.

A minimum of twelve inches of clean, angular crushed stone or dense-graded crushed stone with no more than 6 percent passing a No. 200 sieve is recommended directly below the pad, however a thicker bedding layer of crushed stone may be considered to provided added protection against frost heave. Underslab stone should be placed and compacted as recommended below. If the underslab stone is saturated or trapping water, the water should be removed prior to pad construction.

Seismic Design

Seismic site class is determined in accordance with the International Building Code (IBC). Based on the results of explorations at the site we recommend that the subject project be evaluated using parameters associated with Site Class E.

Liquefaction can occur in loose, saturated, granular soils. Strong shaking, such as that experienced during earthquakes, can cause a sudden loss of shear strength, densification, and subsequent

settlement of these soils. Based on the soil types and consistencies encountered in our explorations, the risk of structurally damaging ground deformations due to liquefaction is low.

Site Grading Recommendations

We understand that the site grades will be increased by up to 2 feet. Over-excavation of existing site soils and replacement with lightweight fill is recommended, as this would allow grade increases to be constructed with little to no net load increase, resulting in little to no settlement and potential impacts to adjacent structures. Proposed fill should be constructed in a manner that limits disturbance and impacts to the proposed and existing structures and utilities to remain.

Possible lightweight fill types include expanded polystyrene fill, commonly referred to as “geofoam”, which has a unit weight of about 1.5 pounds per cubic foot (pcf), or foamed glass aggregate (FGA) which has a dry unit weight of 20 pounds per cubic foot. We recommend a 12-inch-thick soil cover be placed over the lightweight fill. Overexcavation depth required to achieve little to no net load increase is approximately 1.0 foot if geofoam is used, and 1.5 feet if FGA is used. While both fill types are feasible, FGA is recommended for use at this site rather than geofoam for ease of placement and grading.

CONSTRUCTION CONSIDERATIONS

Site Preparation

Prior to earthwork and foundation construction, the site should be prepared by removing existing pavement, concrete slabs, topsoil, existing fill, and abandoned utilities within the limits of all proposed building and equipment pad areas. Deeper stripping depths should be anticipated in areas of thick topsoil typically associated with areas of landscaping, shrubs, hedges, and trees. Utilities should be removed or properly abandoned using Structural Fill, controlled density fill (CDF), or grouting in such a manner to prevent voids.

Root balls from trees may extend several feet and grubbing operations can cause considerable subgrade disturbance. In general, roots greater than one inch in diameter should be removed as well as areas of concentrated smaller roots. All disturbed material should be removed to undisturbed subgrade and the resulting excavation backfilled as recommended herein. In general, the sides of these excavations should be sloped back flatter than 1.5H:1V to help assure that the interface between existing soil and new fill is thoroughly compacted.

Temporary Excavation Support

Excavations will be required for site preparation, overexcavation of existing soils for lightweight fill placement, foundation construction, and utility installation. If temporary excavation slopes are not able to be constructed to due site constraints, temporary excavation support will be required for depths greater than 4 feet and where groundwater seepage is present. Temporary excavation

support may also be required if excavation is necessary adjacent to existing structures, pavements, utilities, and site improvements. We recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation. All excavations should be made in accordance with OSHA safety regulations. We should be retained to provide specific recommendations during construction.

The Contractor should select the type of excavation support system(s) to complete the work. The Contractor's excavation support system should be designed by a professional engineer registered in the State of New Hampshire. The design of the excavation support system should include the full earth, water and surcharge loads that may be encountered during construction. If dewatering is required, the dewatering system should be capable of lowering the groundwater table at least 2 feet below the anticipated excavation depths and be kept operational until fill placement and compaction have been completed to a level of at least 2 feet above the groundwater table elevation.

Subgrade Preparation and Protection

Once excavations have reached proposed subgrade elevations for the building footings and slab, Weston & Sampson should be contacted to observe subgrade conditions prior to placement of crushed stone, fill, concrete, foundation forms, and rebar. Granular subgrades should be recompacted with at least five passes of a vibratory plate compactor. Fine-grained subgrades of silt and clay should be recompacted using static methods. Soft and/or disturbed areas will require additional over-excavation and backfilling with compacted angular crushed stone or compacted Structural Fill to create a stable working pad. A geosynthetic separation fabric between the excavation subgrade and crushed stone backfill may also be required. We recommend that the project budget and schedule include contingencies for over-excavation and stabilization of soft and variable subgrade conditions.

Subgrade soils (after removal of the existing topsoil and fill) are expected to consist of native silty sand or sandy silt. These soils may be susceptible to destabilization during excavation efforts, particularly when saturated. A smooth-edged bucket should be used to establish foundation elevations to reduce subgrade disturbance.

Subgrade protection is the responsibility of the contractor and special precautions and protective measures appropriate for the weather and subgrade conditions should be used during earthwork and foundation construction to preserve the integrity of the subgrades. If construction occurs during freezing conditions, insulating blanket, heaters, or other suitable measures should be employed to prevent foundation subgrades from freezing until the foundations are backfilled sufficiently to prevent frost from reaching foundation subgrades. Fill and/or concrete should not be placed on frozen subgrades.

Fill Materials and Placement

Soil Fill

Imported well graded sand and gravel fill with less than approximately 10 percent fines (such as NHDOT 304.2 Gravel or 304.3 Crushed Gravel) is recommended for use as Structural Fill in foundation areas and as trench backfill within 2 feet of finished grade below proposed pavement areas. Structural Fill material should be placed in maximum 10-inch-thick loose lifts with each lift compaction to a minimum of 95 percent of the materials maximum dry density as determined by ASTM D1557. Fills should be benched into existing slopes, regardless of existing slope inclination such that new fill is placed in horizontal lifts.

On-site granular soils containing less than approximately 20 percent fines and free of organics, contamination (including metals, VOCs, SVOCs, etc.), and other deleterious materials may be suitable for use as Common Fill in areas outside proposed structures and at depths greater than 2 feet below finished grade in pavement areas. Moisture conditioning, if required, could consist of drying by scarification and frequent mixing in thin lifts during warm, dry conditions. Once moisture contents are within 3 percent of optimum, the material should be compacted to at least 92 percent of maximum dry density as determined by ASTM D1557. We anticipate some of the onsite existing fill and native sand will be suitable for reuse as Common Fill.

Crushed Stone

Crushed stone shall consist of durable crushed rock or durable crushed gravel stone, free from ice and snow, sand, clay, loam, or other deleterious or organic material. The crushed stone shall be uniformly blended. Crushed stone should be placed in maximum 10-inch-thick loose lifts and compacted to an unyielding surface. Crushed stone layers greater than 12 inches in thickness should be wrapped with a geosynthetic separation fabric to prevent fines migration into the stone.

Lightweight Fill

Lightweight fill should be used in areas where grade increases are proposed as described herein. Lightweight fill should consist of foamed glass aggregate (FGA) with a dry loose unit weight not less than 12 pcf, a maximum bulk dry loose unit weight of 15 pcf, and a minimum compacted internal friction angle of 40 degrees. Each lift should be compacted by a minimum of 4 passes of a plate-compactor weighing between 110 and 220 pounds, or as recommended by the manufacturer. FGA should be wrapped with a geosynthetic separation fabric to prevent fines migration into the aggregate.

LIMITATIONS

Observation of Construction

Satisfactory earthwork and foundation performance depends to a large degree on the quality of construction. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to evaluate

whether actual subsurface conditions differ from those anticipated. In addition, full-time construction observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications.

The recommendations in this report are preliminary as actual subsurface conditions may differ from those interpreted based on our subsurface explorations. In order for our recommendations to be considered final, we must be retained to observe the actual subsurface conditions encountered during construction. Our observations will allow us to interpret the actual conditions present during construction and adapt our recommendations if needed.

Variations of Subsurface Conditions and Use of Report

We have prepared this report for use by the City of Rochester and the design and construction teams for this project and this site only. The information herein could be used for bidding or estimating purposes but should not be construed as a warranty of subsurface conditions. We have made observations only at the aforementioned locations and only to the stated depths. These observations do not reflect soil types, strata thicknesses, water levels or seepage that may exist at other locations. We should be consulted to review final design and specifications to see that our recommendations are suitably followed. If any changes are made to the anticipated locations, depths, grading, configurations, or construction timing, our recommendations may not be applicable, and we should be consulted. We should also review contractor prepared submittals for temporary excavation support and dewatering.

The preceding recommendations should be considered preliminary, as actual soil conditions may vary. For our recommendations to be final, we should be retained to observe actual subsurface conditions encountered. Our observations will allow us to interpret actual conditions and adapt our recommendations if needed. Within the limitations of scope, schedule and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty, expressed or implied, is given. Please refer to the *Attachment C* for additional information on the use of this report.

It has been a pleasure assisting you with this project and we look forward to our continued involvement. Please call if you have any questions.

Very truly yours,

WESTON & SAMPSON, INC.



Stefanie Bridges, PE (MA)
Geotechnical Project Manager

Jennifer MacGregor, PE
Technical Leader

Attachments:

Figures

Attachment A – Select 90% Design Plans

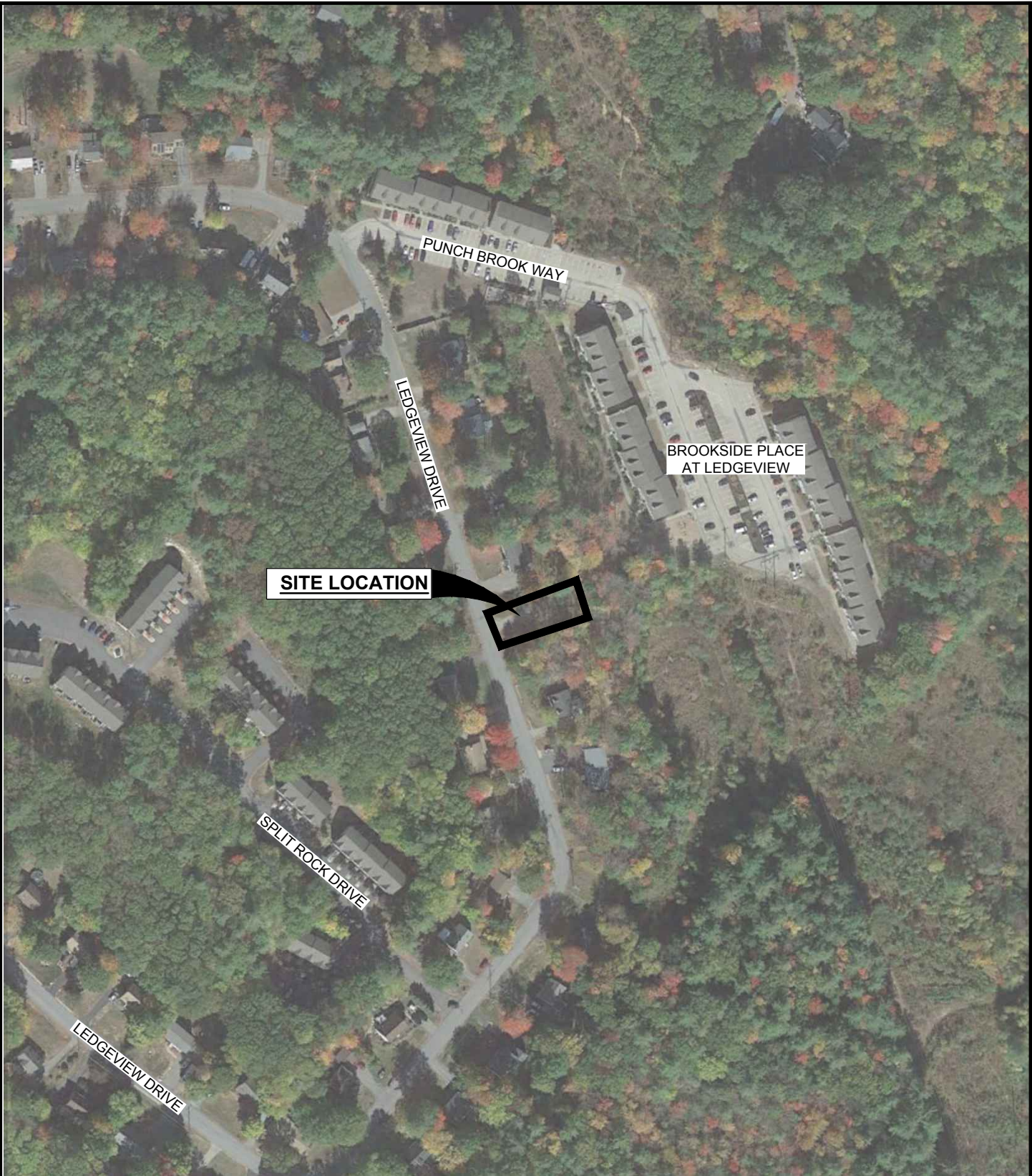
Attachment B – Boring Logs

Attachment C – “Important Information about his Geotechnical-Engineering Report” by GBA, Inc.

SJB

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Figures

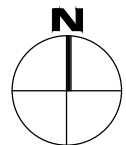
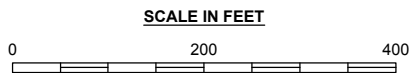


P:\NH\Rochester, NH\ENG23-0387 Ledgeview PS Final Design\200 - Geotechnical\5.0 report\figures\CAD\Figure 1_Locus Map.dwg



**FIGURE 1
LOCUS MAP**

**LEDGEVIEW DRIVE PUMP STATION
ROCHESTER, NEW HAMPSHIRE**

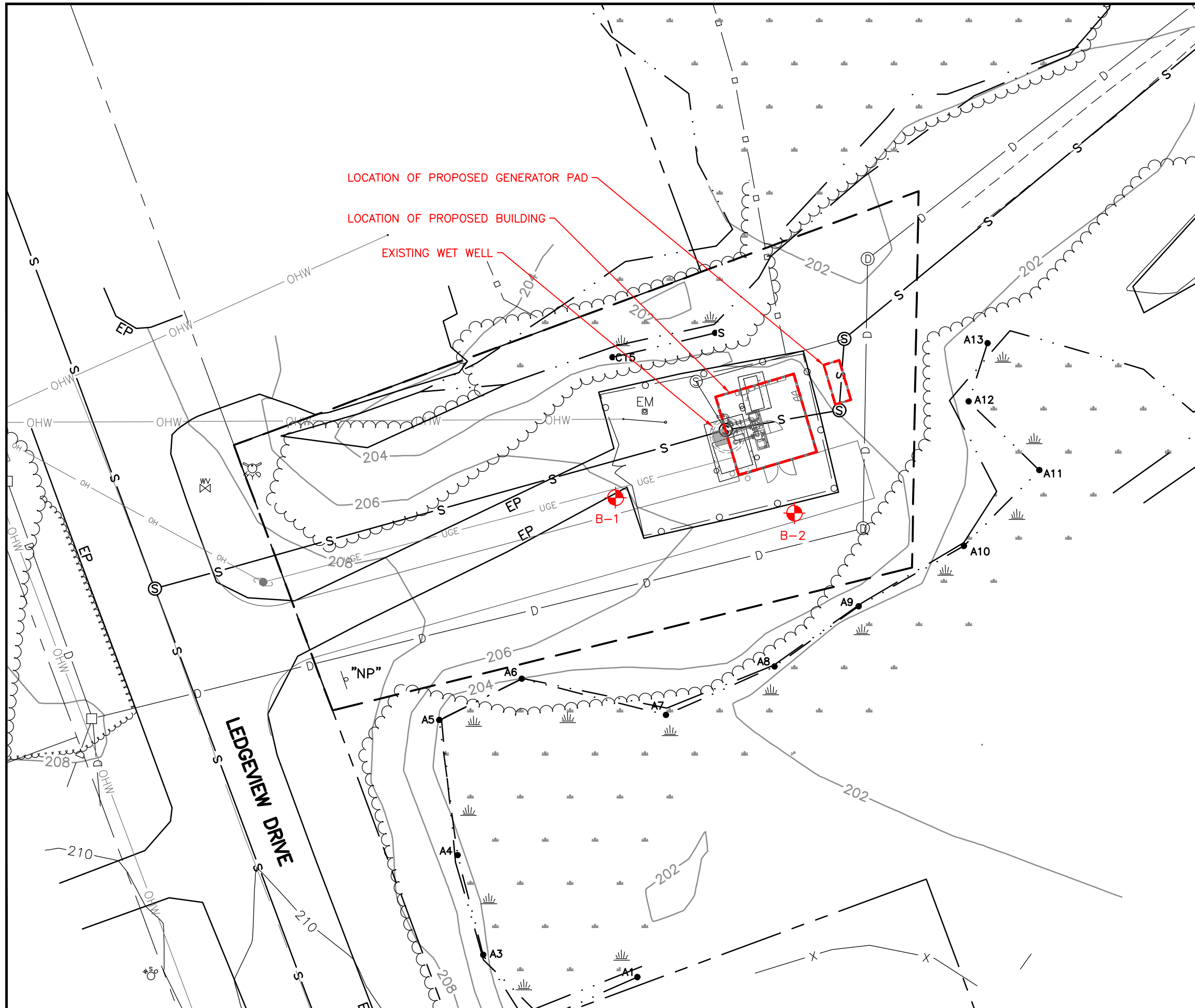


NOTES

- 1) THIS PLAN WAS PREPARED USING A DRAFT EXISTING CONDITIONS PLAN BY WESTON & SAMPSON DATED JANUARY 31, 2024.
- 2) BORINGS WERE ADVANCED BY NEW ENGLAND BORING CONTRACTORS OF DERRY, NEW HAMPSHIRE AND OBSERVED BY WESTON & SAMPSON ON APRIL 5, 2023.
- 3) BORING LOCATIONS ARE LOCATED BASED ON EXISTING SITE FEATURES AND ARE APPROXIMATE.

LEGEND

 B-X DESIGNATION AND APPROXIMATE LOCATION OF BORING



GRAPHIC SCALE



SCALE: 1"=20'

ORIENTATION



TITLE

SITE PLAN
 PROJECT
**LEDGEVIEW DRIVE
 PUMP STATION**
 ROCHESTER, NEW HAMPSHIRE

DATE	02/2024
DRWN BY	NMK
CHKD BY	SJB
PRJ. NO.	ENG23-0367
REV. NO.	-

FIGURE

FIGURE 2

Attachment A

Select Draft 90% Design Plans

DRAFT

CITY OF ROCHESTER, NEW HAMPSHIRE

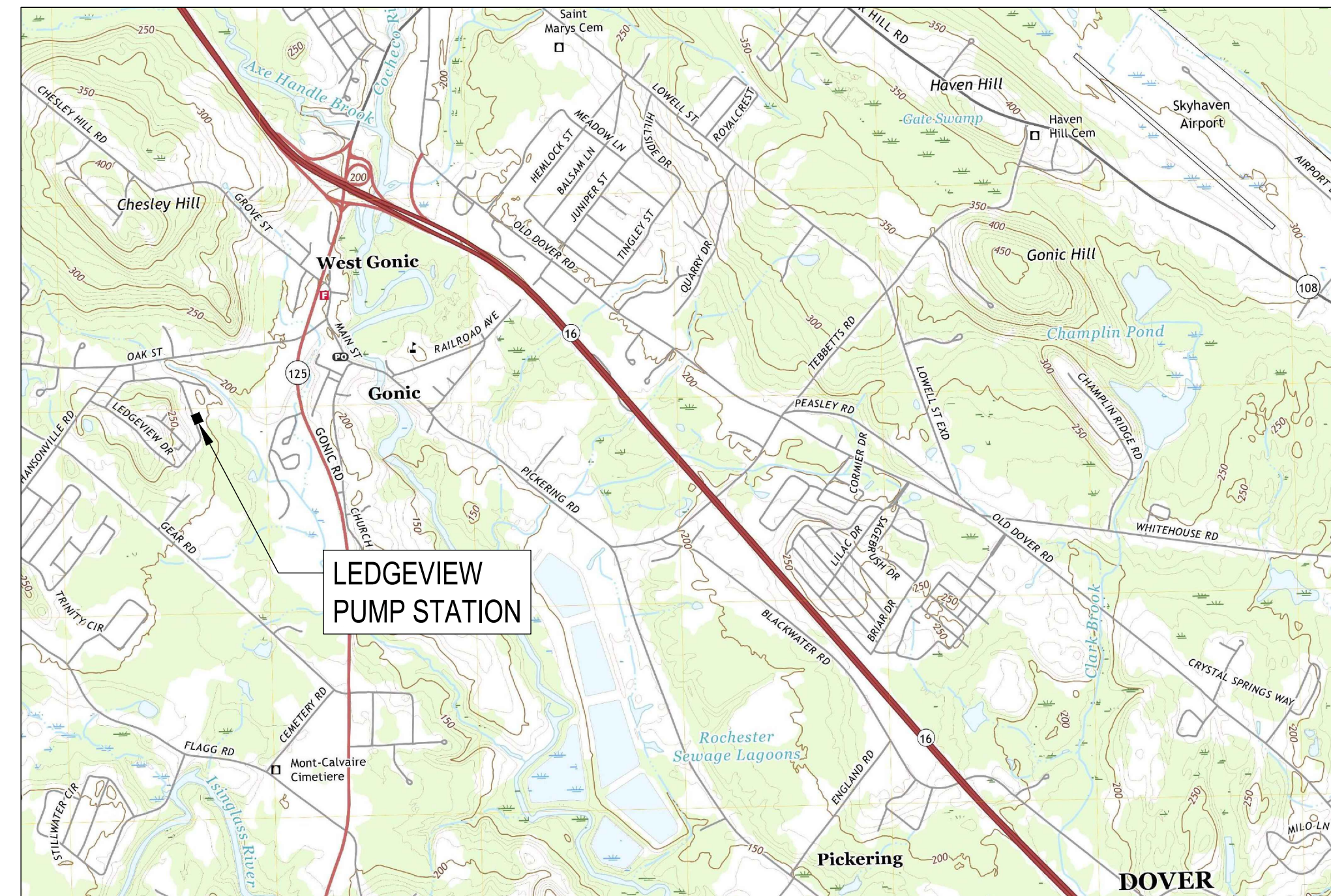
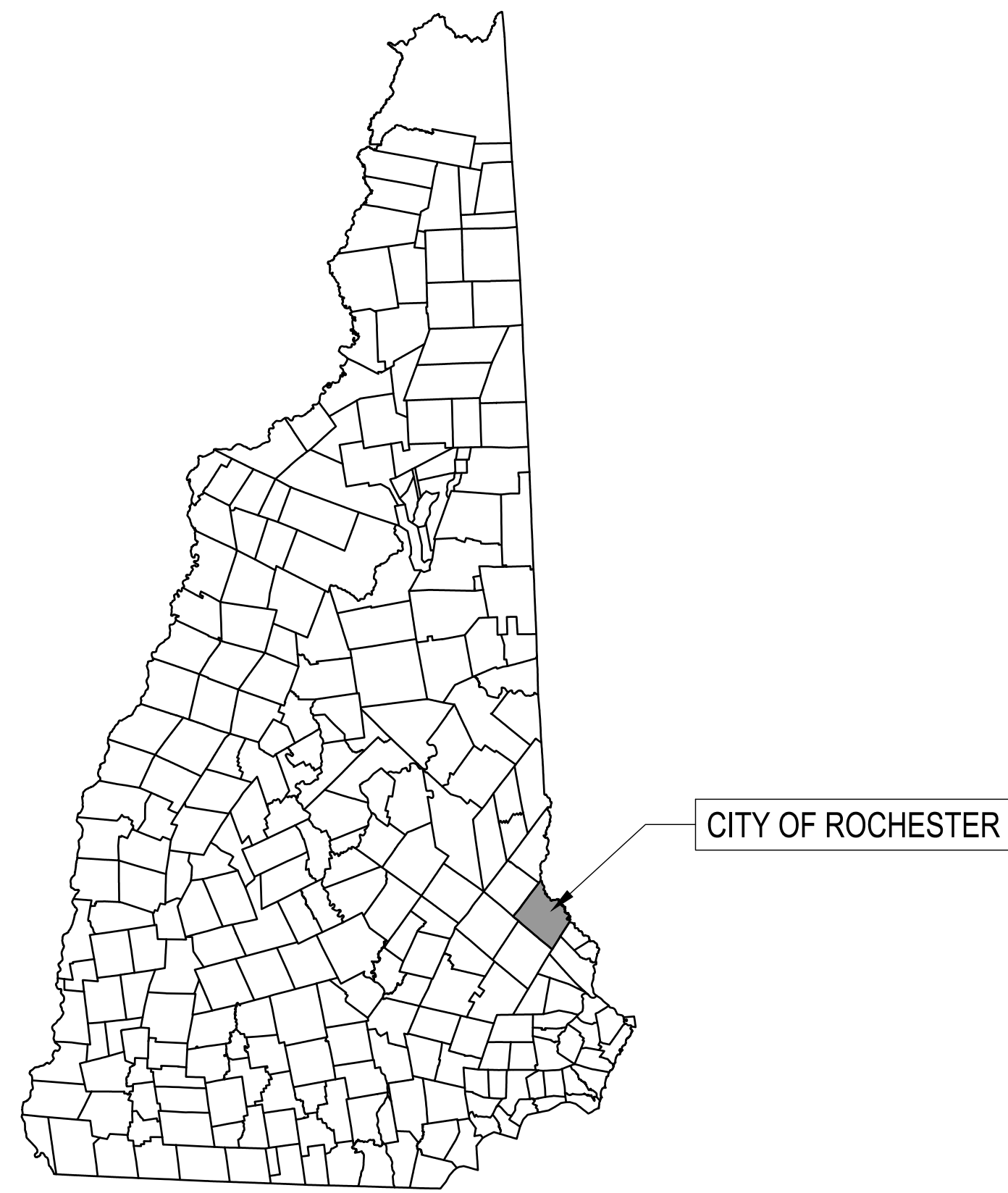
LEDGEVIEW SEWER PUMP STATION UPGRADE

54A LEDGEVIEW DRIVE, ROCHESTER, NEW HAMPSHIRE, 03868

CLEAN WATER STATE REVOLVING FUND: CS-334122-21

CITY OF ROCHESTER: RFP 24 - 31

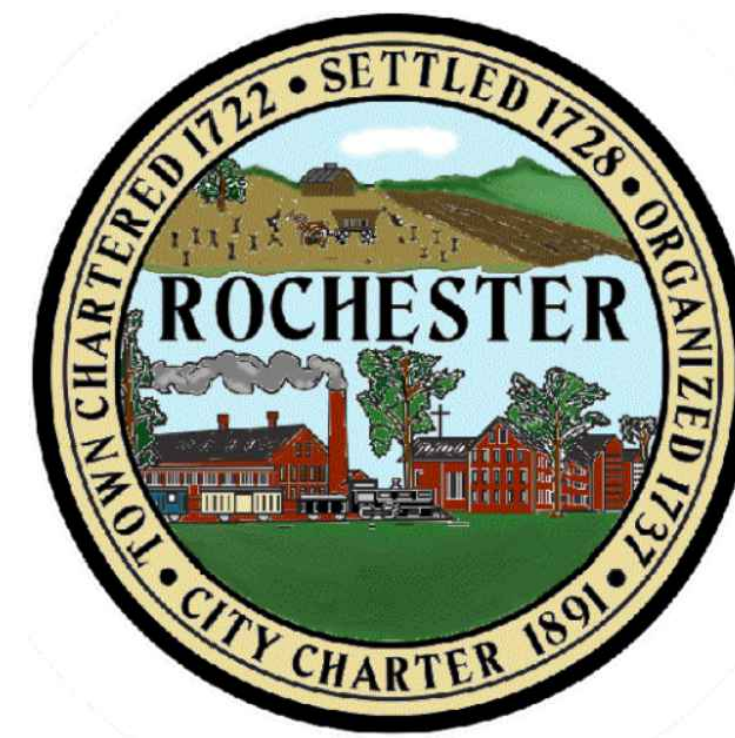
Weston & Sampson
 Weston & Sampson Engineers, Inc.
 100 International Drive, Suite 152
 Portsmouth, NH 03801
 978.532.1900 800.SAMPSON
 www.westonandsampson.com



DRAWING INDEX	
SHEET	TITLE
G000	COVER AND SHEET LIST
G001	ABBREVIATIONS, NOTES, AND LEGEND
C100	EXISTING CONDITIONS
C101	DEMOLITION PLAN
C102	PROPOSED SITE PLAN
C103	EASEMENT PLAN
C501	CIVIL DETAILS I
C502	CIVIL DETAILS II
C503	CIVIL DETAILS III
A001	ABBREVIATIONS, SYMBOLS, LEGEND & GENERAL NOTES
A101	OVERALL FLOOR PLANS
A231	3D VIEWS
A401	BUILDING SECTIONS, WALL SECTIONS & DETAILS
A801	LOUVER, DOOR, AND FRAME TYPE DETAILS
S001	GENERAL NOTES AND TYPICAL DETAILS
S111	FOUNDATION PLAN AND DETAILS
S112	3D VIEWS AND ELEVATIONS
M101	PROCESS DEMOLITION PLANS
M102	PROCESS PLANS AND SECTIONS
M501	PROCESS DETAILS
H000	LEGENDS, NOTES, AND ABBREVIATIONS
H101	FIRST FLOOR NEW WORK DUCT PLAN
H501	DETAILS, SCHEDULES, AND AUTOMATIC TEMPERATURE CONTROLS
E001	ELECTRICAL LEGEND, NOTES, AND ABBREVIATIONS
ED101	ELECTRICAL DEMOLITION SITE PLAN
E002	ELECTRICAL SITE PLAN
E101	ELECTRICAL FLOOR PLAN
E501	ELECTRICAL DIAGRAMS, DETAILS & SCHEDULES



AERIAL MAP
NOT TO SCALE



SEAL
NOT TO SCALE

Issued Date:

3/1/2024



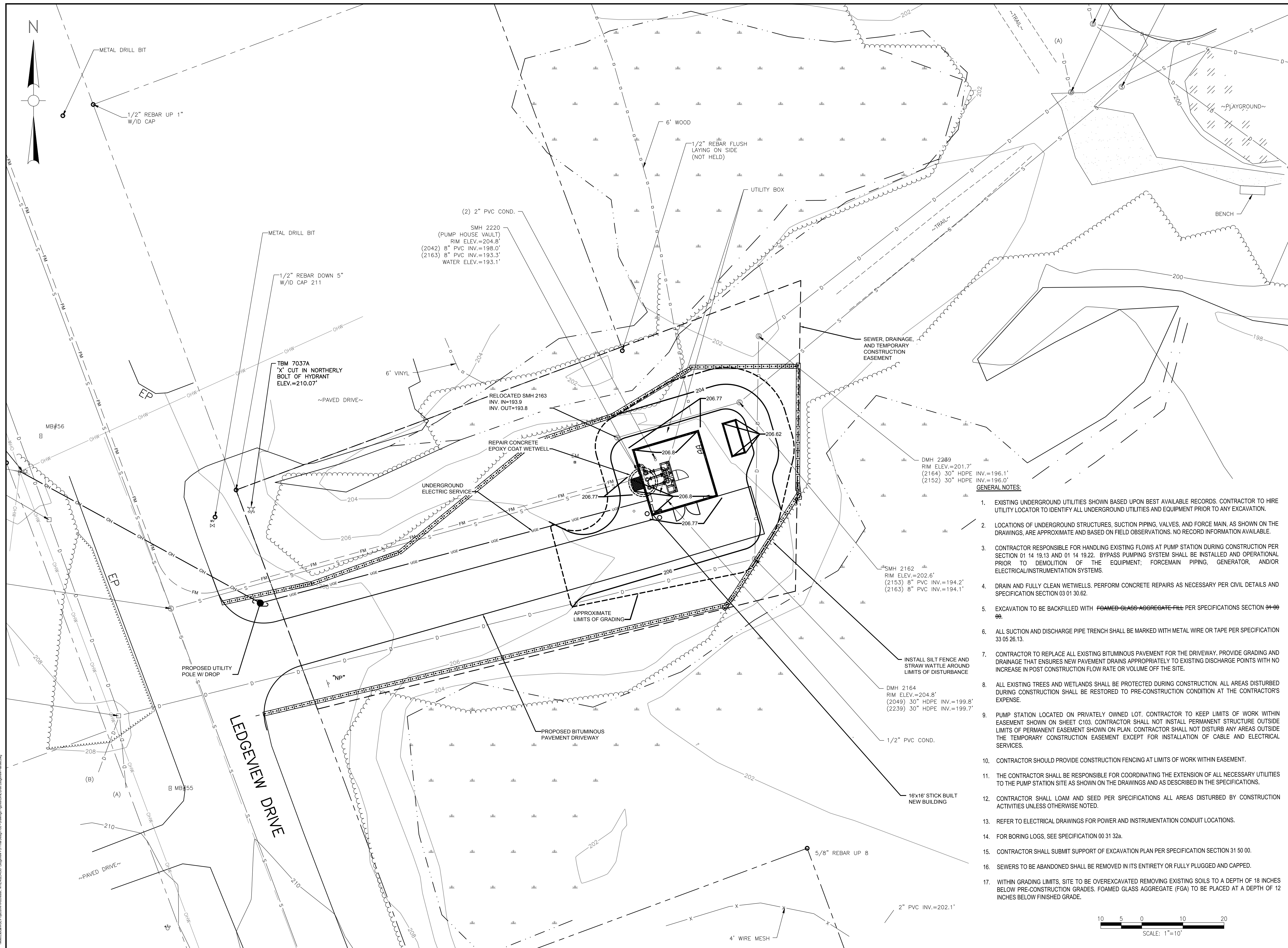
Know what's below.
Call before you dig.

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DRAFT

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Consultants:

Revisions:

No.	Date	Description

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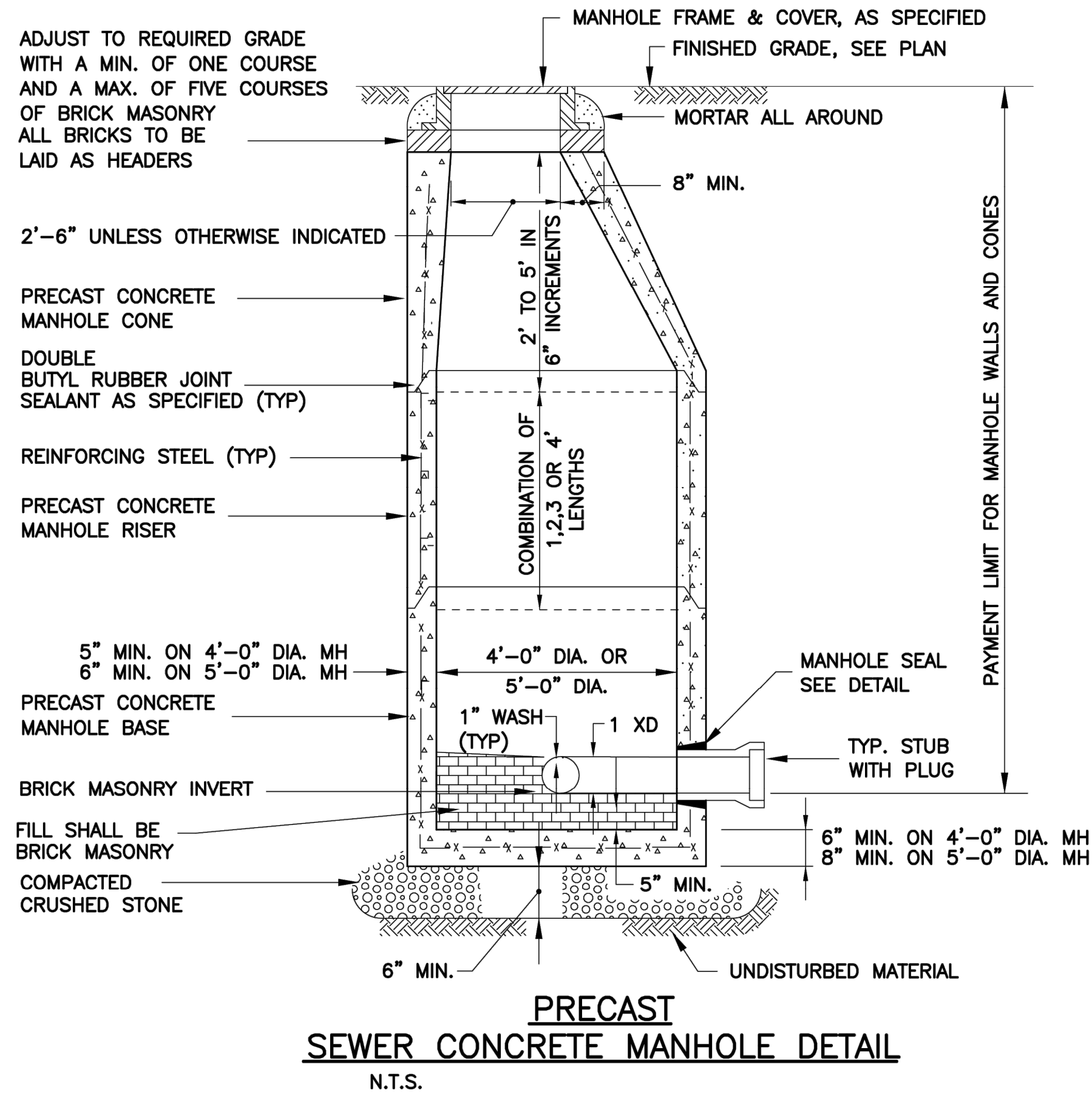
- Seal:
- EXISTING UNDERGROUND UTILITIES SHOWN BASED UPON BEST AVAILABLE RECORDS. CONTRACTOR TO HIRE UTILITY LOCATOR TO IDENTIFY ALL UNDERGROUND UTILITIES AND EQUIPMENT PRIOR TO ANY EXCAVATION.
 - LOCATIONS OF UNDERGROUND STRUCTURES, SUCTION PIPING, VALVES, AND FORCE MAIN, AS SHOWN ON THE DRAWINGS, ARE APPROXIMATE AND BASED ON FIELD OBSERVATIONS. NO RECORD INFORMATION AVAILABLE.
 - CONTRACTOR RESPONSIBLE FOR HANDLING EXISTING FLOWS AT PUMP STATION DURING CONSTRUCTION PER SECTION 01 14 19.13 AND 01 14 19.22. BYPASS PUMPING SYSTEM SHALL BE INSTALLED AND OPERATIONAL PRIOR TO DEMOLITION OF THE EQUIPMENT; FORCEMAIN PIPING, GENERATOR, AND/OR ELECTRICAL/INSTRUMENTATION SYSTEMS.
 - DRAIN AND FULLY CLEAN WETWELLS. PERFORM CONCRETE REPAIRS AS NECESSARY PER CIVIL DETAILS AND SPECIFICATION SECTION 03 01 30.62.
 - EXCAVATION TO BE BACKFILLED WITH ~~FOAMED GLASS AGGREGATE FILL~~ PER SPECIFICATIONS SECTION ~~31 05 00~~ 31 05 26.13.
 - ALL SUCTION AND DISCHARGE PIPE TRENCH SHALL BE MARKED WITH METAL WIRE OR TAPE PER SPECIFICATION 33 05 26.13.
 - CONTRACTOR TO REPLACE ALL EXISTING BITUMINOUS PAVEMENT FOR THE DRIVEWAY. PROVIDE GRADING AND DRAINAGE THAT ENSURES NEW PAVEMENT DRAINS APPROPRIATELY TO EXISTING DISCHARGE POINTS WITH NO INCREASE IN POST CONSTRUCTION FLOW RATE OR VOLUME OFF THE SITE.
 - ALL EXISTING TREES AND WETLANDS SHALL BE PROTECTED DURING CONSTRUCTION. ALL AREAS DISTURBED DURING CONSTRUCTION SHALL BE RESTORED TO PRE-CONSTRUCTION CONDITION AT THE CONTRACTOR'S EXPENSE.
 - PUMP STATION LOCATED ON PRIVATELY OWNED LOT. CONTRACTOR TO KEEP LIMITS OF WORK WITHIN EASEMENT SHOWN ON SHEET C103. CONTRACTOR SHALL NOT INSTALL PERMANENT STRUCTURE OUTSIDE LIMITS OF PERMANENT EASEMENT SHOWN ON PLAN. CONTRACTOR SHALL NOT DISTURB ANY AREAS OUTSIDE THE TEMPORARY CONSTRUCTION EASEMENT EXCEPT FOR INSTALLATION OF CABLE AND ELECTRICAL SERVICES.
 - CONTRACTOR SHOULD PROVIDE CONSTRUCTION FENCING AT LIMITS OF WORK WITHIN EASEMENT.
 - THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING THE EXTENSION OF ALL NECESSARY UTILITIES TO THE PUMP STATION SITE AS SHOWN ON THE DRAWINGS AND AS DESCRIBED IN THE SPECIFICATIONS.
 - CONTRACTOR SHALL LOAM AND SEED PER SPECIFICATIONS ALL AREAS DISTURBED BY CONSTRUCTION ACTIVITIES UNLESS OTHERWISE NOTED.
 - REFER TO ELECTRICAL DRAWINGS FOR POWER AND INSTRUMENTATION CONDUIT LOCATIONS.
 - FOR BORING LOGS, SEE SPECIFICATION 00 31 32a.
 - CONTRACTOR SHALL SUBMIT SUPPORT OF EXCAVATION PLAN PER SPECIFICATION SECTION 31 50 00.
 - SEWERS TO BE ABANDONED SHALL BE REMOVED IN ITS ENTIRETY OR FULLY PLUGGED AND CAPPED.
 - WITHIN GRADING LIMITS, SITE TO BE OVEREXCAVATED REMOVING EXISTING SOILS TO A DEPTH OF 18 INCHES BELOW PRE-CONSTRUCTION GRADES. FOAMED GLASS AGGREGATE (FGA) TO BE PLACED AT A DEPTH OF 12 INCHES BELOW FINISHED GRADE.

Issued For:
DRAFT
 Scale: 1/8" = 1'-0"

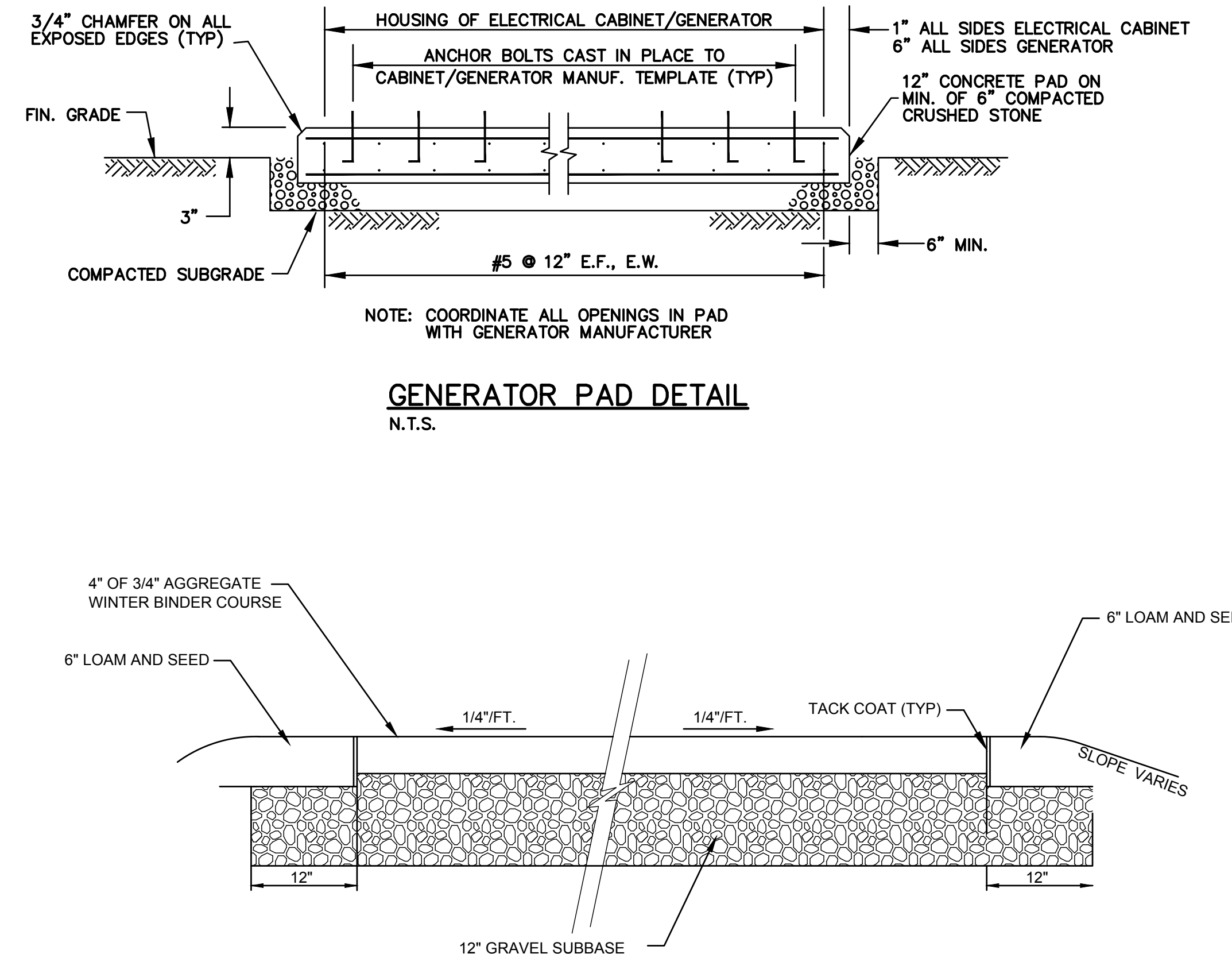
Date: 3/1/2024
 Drawn By: AJB
 Reviewed By: JMS
 Approved By: CMP
 W&S Project No.: ENG23-0367
 W&S File No.:

Drawing Title:
PROPOSED SITE PLAN

Sheet Number:
C102
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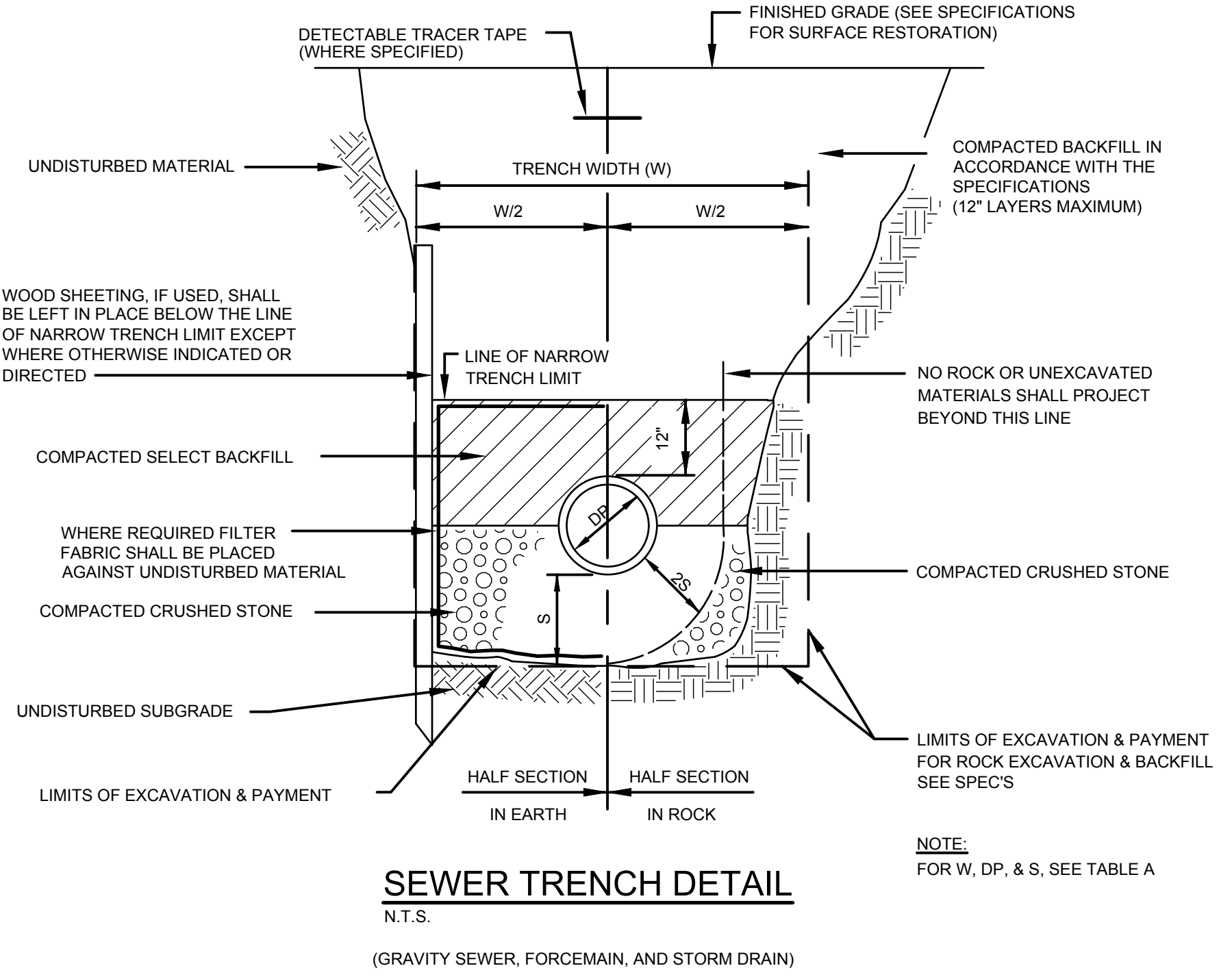
PRECAST SEWER CONCRETE MANHOLE DETAIL
N.T.S.



GENERATOR PAD DETAIL
N.T.S.



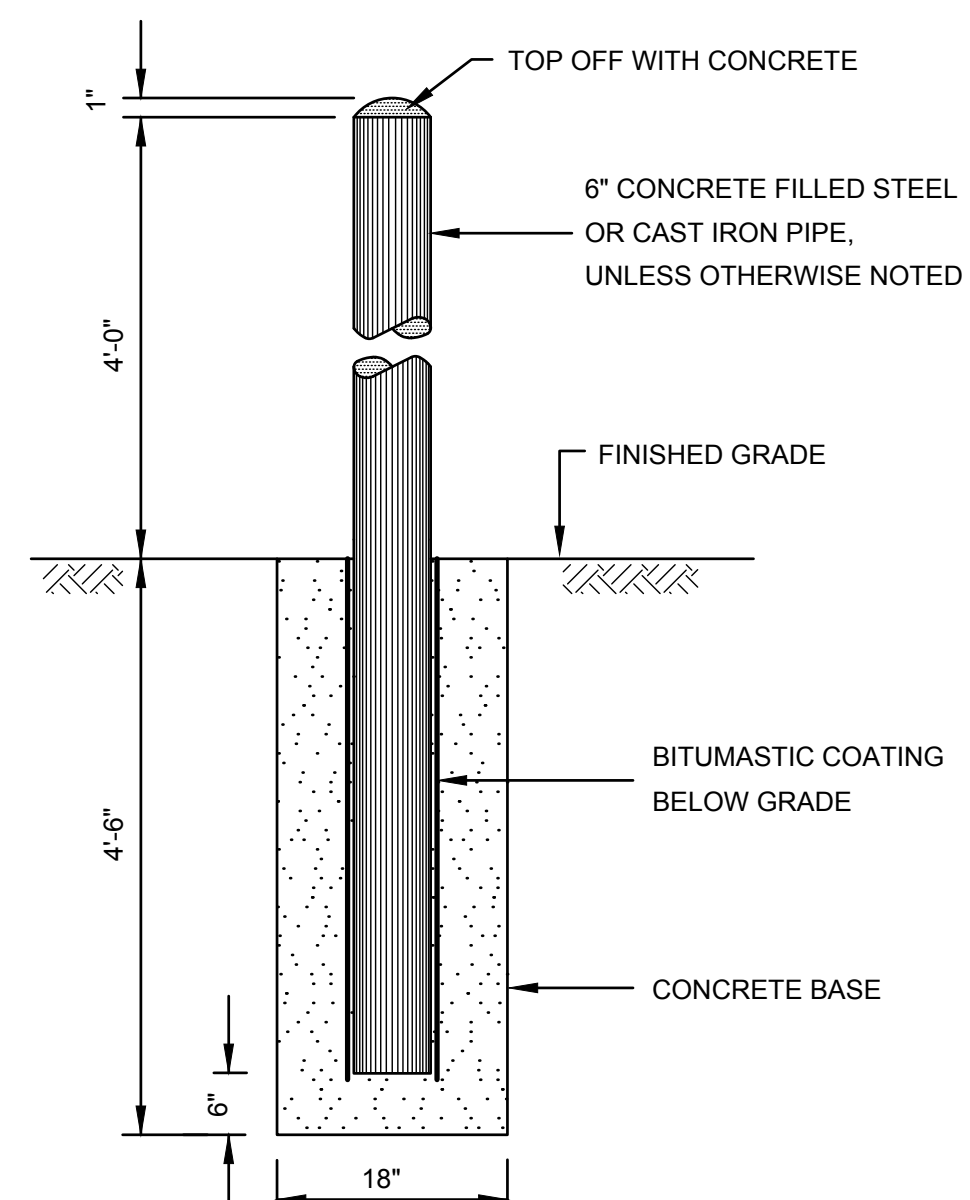
PARKING LOTS AND DRIVEWAYS
N.T.S.



SEWER TRENCH DETAIL
N.T.S.

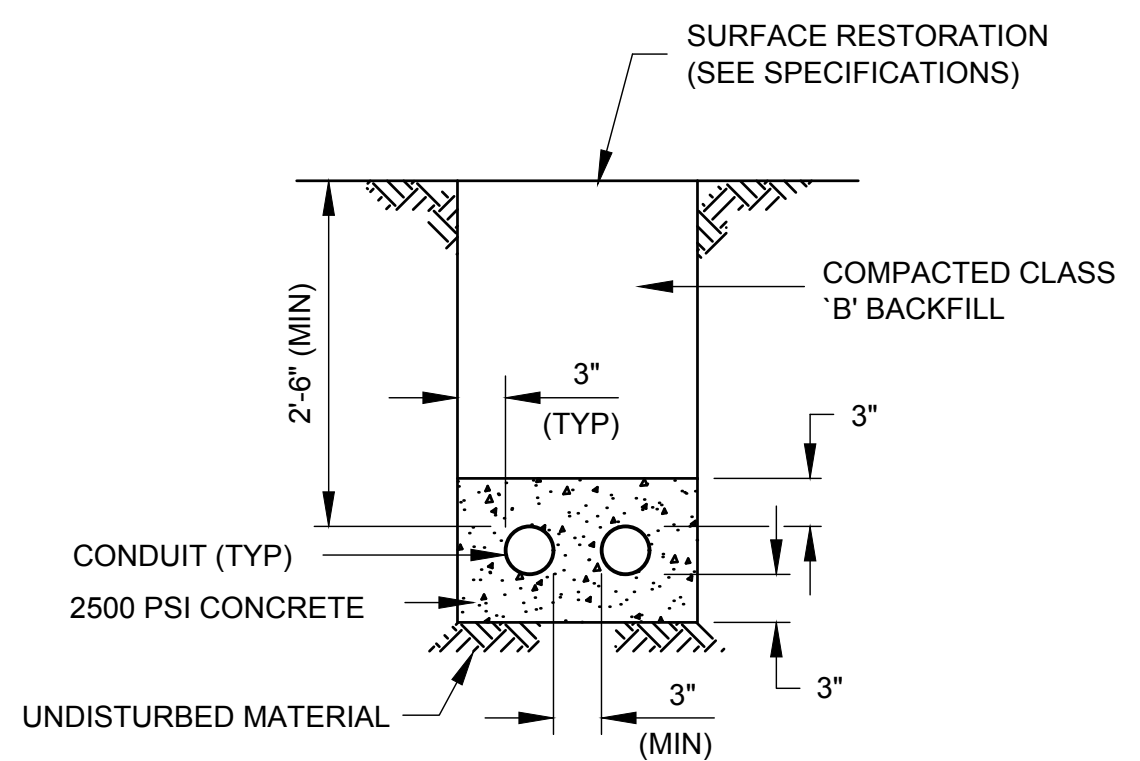
DIAMETER OF PIPE (DP)	MAXIMUM TRENCH WIDTH BELOW LINE OF NARROW TRENCH LIMIT (SHEETED OR UNSHEETED) (W)	MINIMUM CLEARANCE (S)
<15"	36"	6"

TABLE A

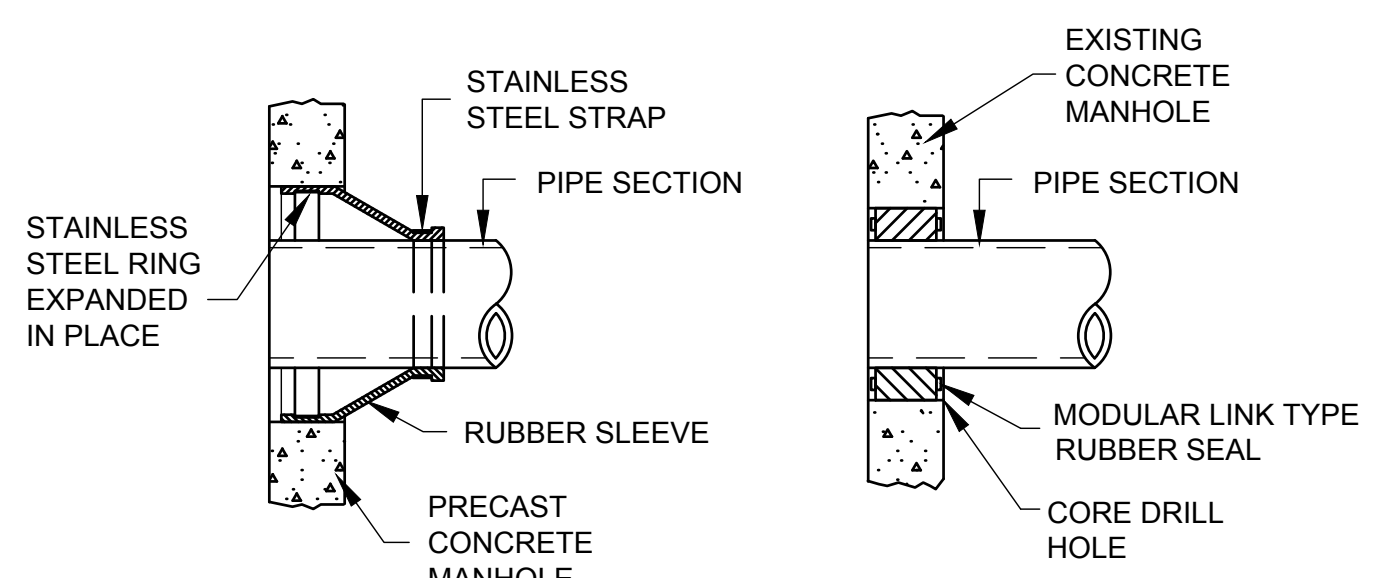


BOLLARD DETAIL
N.T.S.

- NOTES:**
- PIPE SHALL BE PAINTED SAFETY YELLOW WITH CATALYZED EPOXY PAINT.
 - POST SHALL BE COVERED WITH 1/2" THICK HDPE SAFETY YELLOW BOLLARD COVER BY POST GUARD OR APPROVED EQUAL.

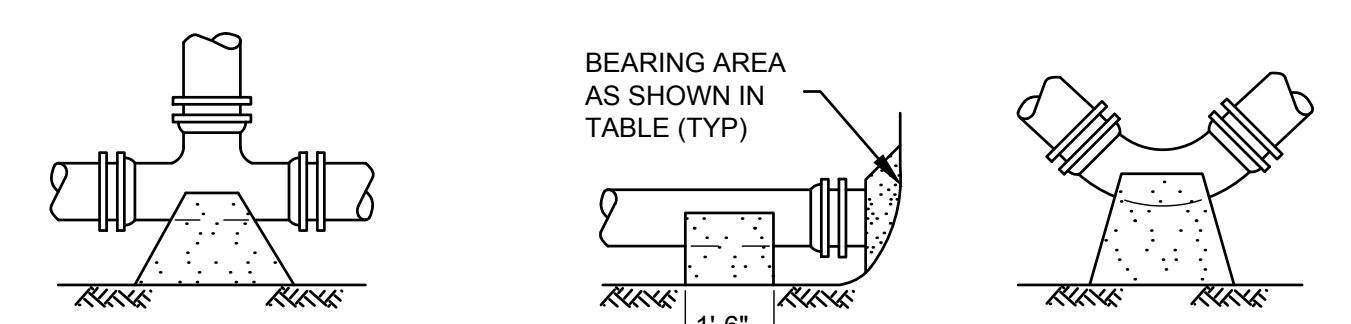


ELECTRICAL DUCTBANK DETAIL
N.T.S.



WETWELL AND MANHOLE SEAL DETAILS
N.T.S.

- NOTES:**
- ALL PENETRATIONS INTO THE WETWELL AND AIR RELEASE VALVE MANHOLE SHALL BE VAPOR AND GAS TIGHT.

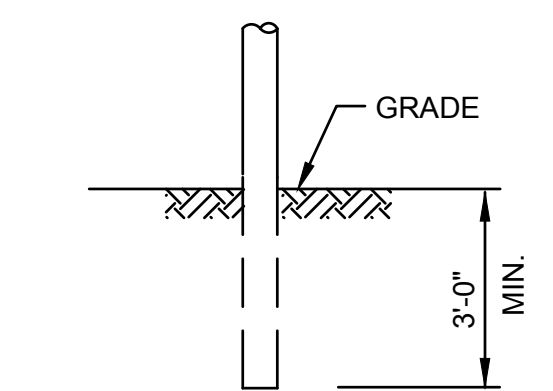


TEE DETAIL (PLAN VIEW) CAP DETAIL (PLUG SIMILAR) (SECTION VIEW) BEND DETAIL (PLAN VIEW)

SIZE OF MAIN	90° BENDS, TEES, CAPS AND PLUGS	45° BENDS AND WYES	22-12° BENDS	11-14° BENDS
6", 8"	5	4	2	2
10", 12"	12	9	5	2

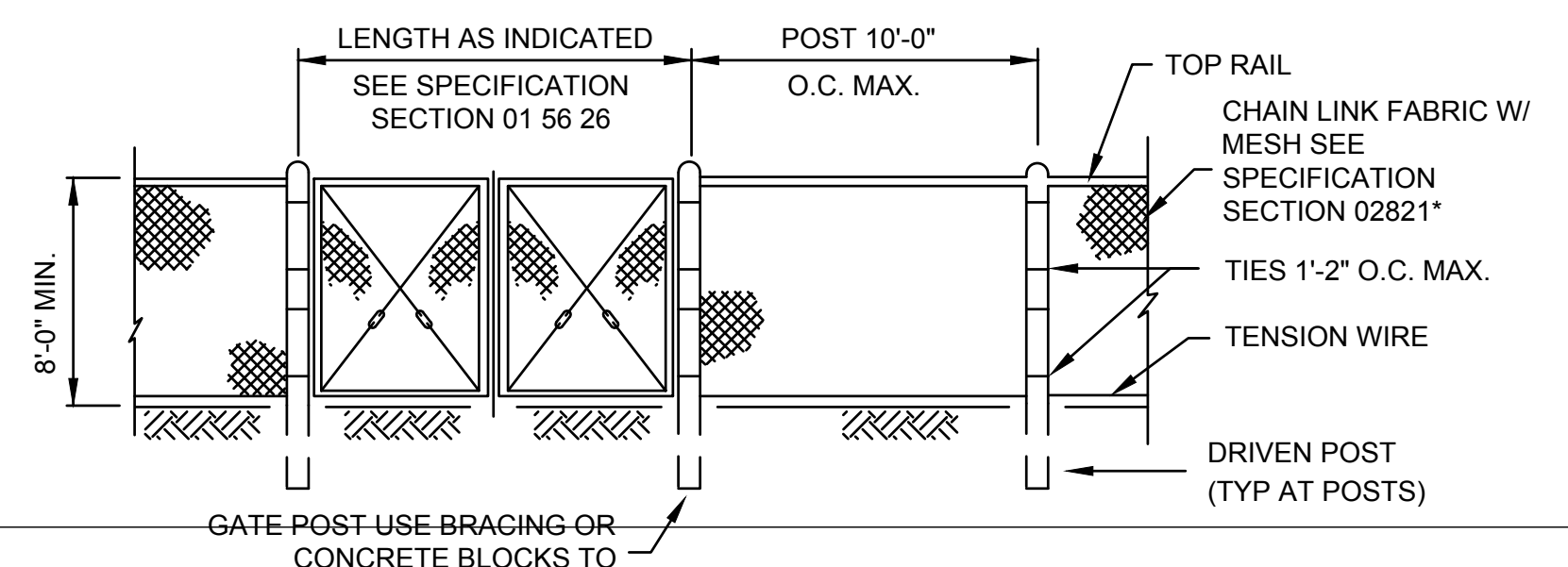
CONCRETE THRUST RESTRAINT FOR FITTINGS
N.T.S.

- NOTES:**
- CONCRETE THRUST RESTRAINT SHALL ONLY BE USED WHERE OTHER MEANS OF RESTRAINT ARE NOT FEASIBLE.
 - CONTRACTOR SHALL USE CARE TO AVOID PLACEMENT OF CONCRETE ON THE FITTING JOINTS.



DRIVEN POST DETAIL
N.T.S.

- NOTES:**
- SEE SPECIFICATION SECTION 01 56 26-TEMPORARY CHAIN LINK FENCE
 - PORTABLE/TEMPORARY CHAIN LINK FENCE IS ALLOWABLE.



TEMPORARY CHAIN LINK FENCE AND GATE DETAIL
N.T.S.

Consultants:

No.	Date	Description

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Approved By: CMP
W&S Project No.: ENG23-0367
W&S File No.:

Drawing Title:
CIVIL DETAILS

Sheet Number:
C501

STRUCTURAL REPAIR NOTES:

GENERAL REPAIR NOTES:

- 1. WETWELL SHOULD BE THOROUGHLY CLEANED AND POWER WASHED CAREFULLY PRIOR TO ANY OF THE CONCRETE REPAIR PROCEDURES LISTED BELOW.
- 2. CONTRACTOR TO ASSUME PARTIAL DEPTH CONCRETE REPAIR IS NOT NECESSARY. LIMITS TO BE DETERMINED DURING FIELD SURVEY.
- 3. COATINGS SHALL BE APPLIED AFTER COMPLETION OF CRACK REPAIRS, FLOOR SLOPE MODIFICATIONS, AND INSTALLATION OF TOP SLAB/CURB.

EPOXY INJECTION CRACK REPAIR:

- 4. CONTRACTOR TO PERFORM FIELD SURVEY TO DETERMINE LIMITS OF CRACKS AND REQUIRED REPAIRS.
- 5. AFTER APPROVAL OF LIMITS IS RECEIVED FROM ENGINEER, CONCRETE CRACKS SHALL BE REPAIRED BY EPOXY INJECTION.
- 6. CRACKS SHALL BE CLEANED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS PRIOR TO INSTALLATION OF INJECTION PORTS.
- 7. CLEAN AREAS TO RECEIVE CAPPING ADHESIVE OF OIL, DIRT, AND OTHER SUBSTANCES THAT WOULD INTERFERE WITH BOND, AND CLEAN CRACKS WITH OIL-FREE COMPRESSED AIR OR LOW-PRESSURE WATER TO REMOVE LOOSE PARTICLES.
- 8. PLACE INJECTION PORTS AS RECOMMENDED BY EPOXY MANUFACTURER, SPACING NO FARTHER APART THAN THICKNESS OF MEMBER BEING INJECTED. SEAL INJECTION PORTS IN PLACE WITH CAPPING ADHESIVE.
- 9. SEAL CRACKS AT EXPOSED SURFACES WITH A RIBBON OF CAPPING ADHESIVE AT LEAST 1/4 INCH THICK BY 1 INCH WIDER THAN CRACK.
- 10. INJECT CRACKS WITH A WIDTH OF 0.005 INCH TO 0.25 INCH.
- 11. INJECT EPOXY ADHESIVE, BEGINNING AT WIDEST PART OF CRACK AND WORKING TOWARD NARROWER PARTS. INJECT ADHESIVE INTO PORTS TO REFUSAL, CAPPING ADJACENT PORTS WHEN THEY EXTRUDE EPOXY. CAP INJECTED PORTS AND INJECT THROUGH ADJACENT PORTS UNTIL CRACK IS FILLED.
- 12. AFTER EPOXY ADHESIVE HAS SET, REMOVE INJECTION PORTS, AND GRIND SURFACES SMOOTH.

PARTIAL DEPTH REPAIR NOTES:

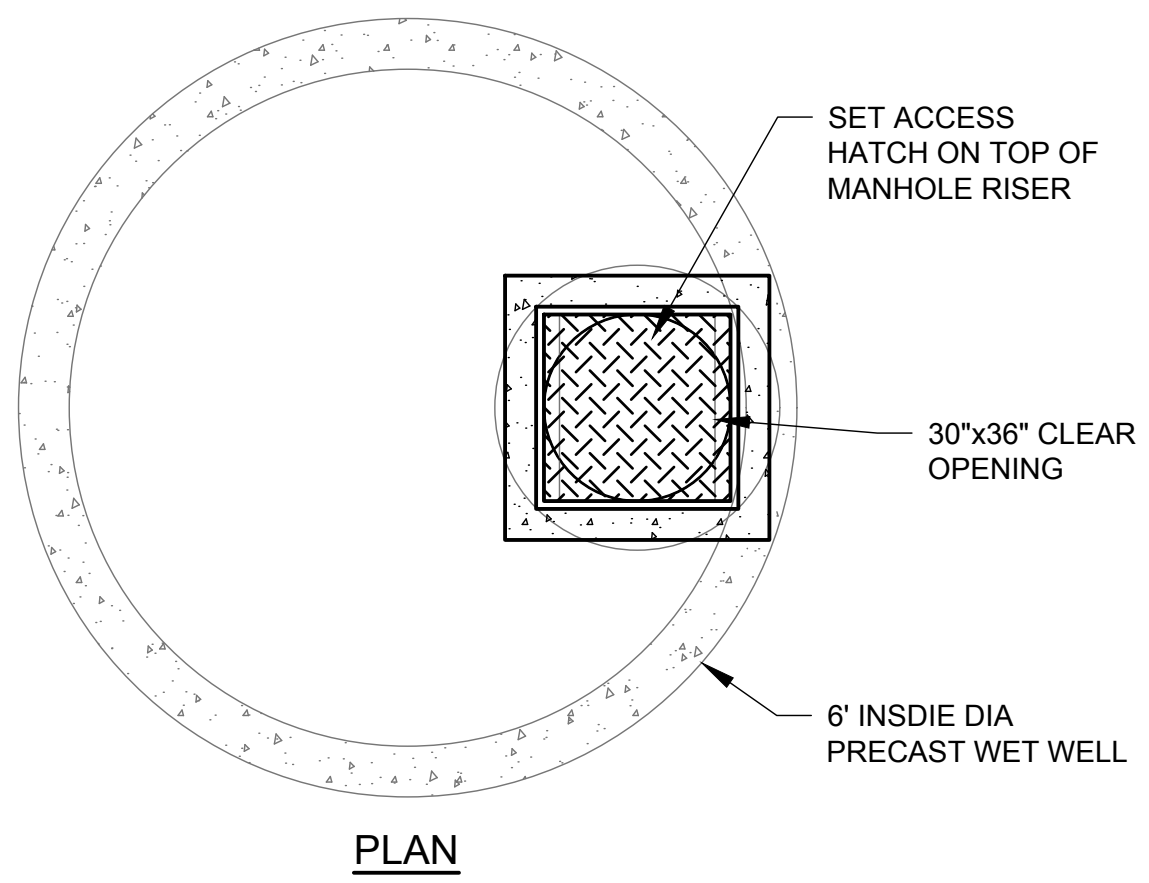
- 13. CONTRACTOR TO PERFORM FIELD SURVEY TO DETERMINE LIMITS OF DETERIORATION AND REQUIRED REPAIRS. THIS SURVEY SHALL INCLUDE THE WETWELL FLOOR AND SIDEWALLS.
- 14. AFTER APPROVAL OF LIMITS RECEIVED FROM ENGINEER, CONTRACTOR TO REMOVE DETERIORATED CONCRETE TO SOUND CONCRETE AT REPAIR LOCATIONS.
- 15. IF MORE THAN 50% OF A PIECE OF REINFORCING STEEL IS EXPOSED, THE CONCRETE SHALL BE REMOVED TO A MINIMUM OF 1" AROUND THE REINFORCING STEEL AS SHOWN ABOVE.
- 16. IF REINFORCING STEEL IS FOUND TO BE DETERIORATED, SUPPLEMENTARY REINFORCING STEEL IS TO BE PROVIDED.
 - 16.1. PROVIDE 2 - #5 BARS TO SUPPLEMENT A DETERIORATED 3/4" SQUARE BAR.
 - 16.2. PROVIDE 1 - #4 BAR TO SUPPLEMENT A DETERIORATED WIRE TIE.
- 17. SUPPLEMENTARY REINFORCEMENT TO BE LAPPED WITH EXISTING REINFORCEMENT.
- 18. CONCRETE SURFACE SHALL BE DAMPENED PRIOR TO PATCHING IN ACCORDANCE WITH SPECIAL PROVISIONS.
- 19. IF LIMITS OF REPAIR ARE LESS THAN 2" DEEP, TYPE A REPAIR IS TO BE PERFORMED AS SHOWN BELOW.
 - 19.1. TYPE A REPAIRS TO BE PATCHED WITH MATERIAL AS SPECIFIED IN SPECIAL PROVISIONS FOR CEMENTITIOUS MORTAR FOR PATCHING.
- 20. IF LIMITS OF REPAIR ARE MORE THAN 2" DEEP, TYPE B REPAIR IS TO BE PERFORMED AS SHOWN BELOW.
 - 20.1. TYPE B REPAIRS TO BE PATCHED WITH 5000 PSI - 3/8" CEMENT CONCRETE.
- 21. ALL PATCHES TO BE FINISHED FLUSH WITH SURROUNDING CONCRETE SURFACE.

SKIM COAT:

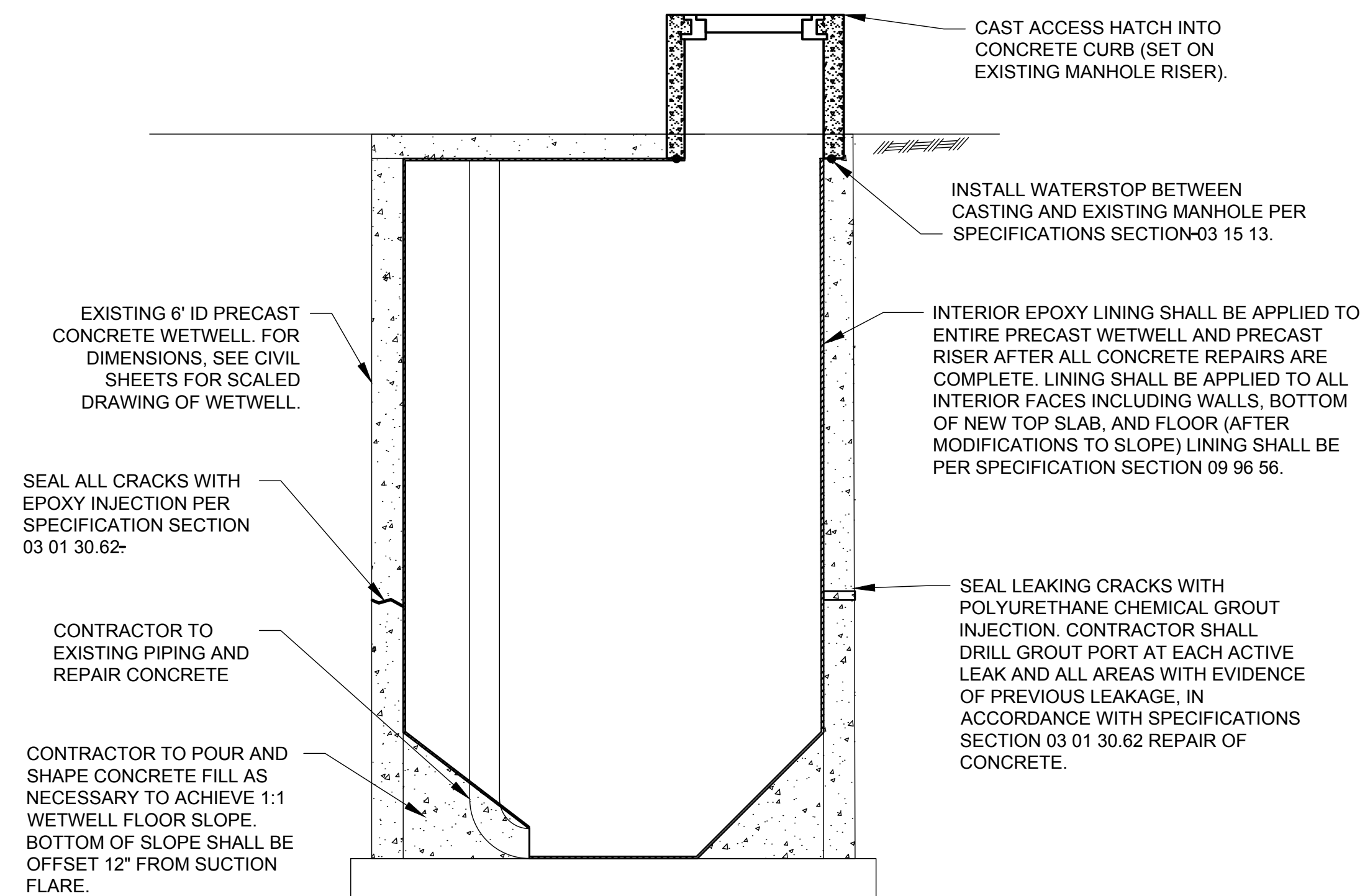
- 22. ALL LOOSE OR FLAKING MATERIAL TO BE REMOVED FROM EXISTING FACE OF CONCRETE SURFACE.
- 23. SKIM COAT TO BE APPLIED PER THE MANUFACTURER'S SPECIFICATIONS AND MUST MATCH EXISTING THICKNESS ON FACE OF CONCRETE SURFACE.
- 24. SKIM COAT SHOULD BE ONE OF THE FOLLOWING OR EQUAL:
 - 24.1. TNEMEC SERIES 218/219 MORTAR CLAD OR APPROVED EQUAL.

PROTECTIVE COATING ON WETWELL INTERIOR WALLS:

- 25. PROTECTIVE COATING TO BE APPLIED PER THE MANUFACTURER'S SPECIFICATIONS.
- 26. TWO TOP COATS SHALL BE APPLIED WITH TOTAL DRY THICKNESS OF 80 MILS.
- 27. ENTIRE INTERIOR OF STRUCTURE SHALL BE COATED INCLUDING BOTTOM OF TOP SLAB AND SLOPED FLOORS.
- 28. PROTECTIVE COATING SHOULD BE ONE OF THE FOLLOWING OR EQUAL:
 - 28.1. TNEMEC SERIES 435 PERMA-GLAZE OR APPROVED EQUAL.



PLAN



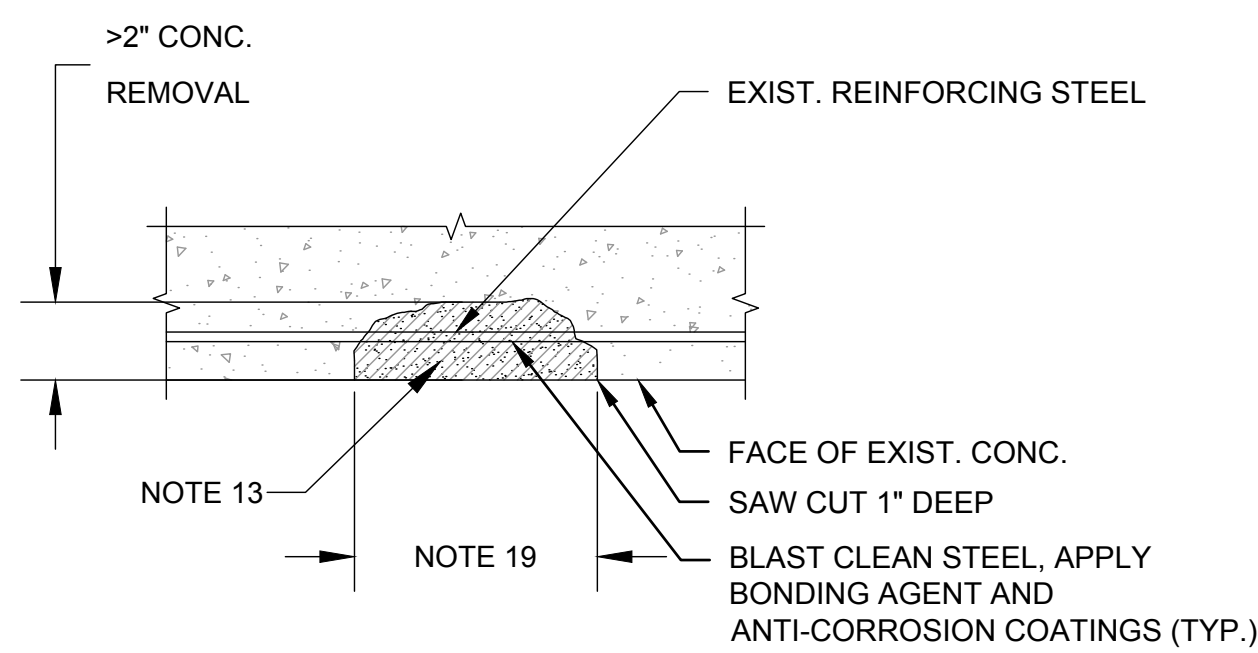
SECTION

WETWELL REPAIR AND MODIFICATIONS

N.T.S.

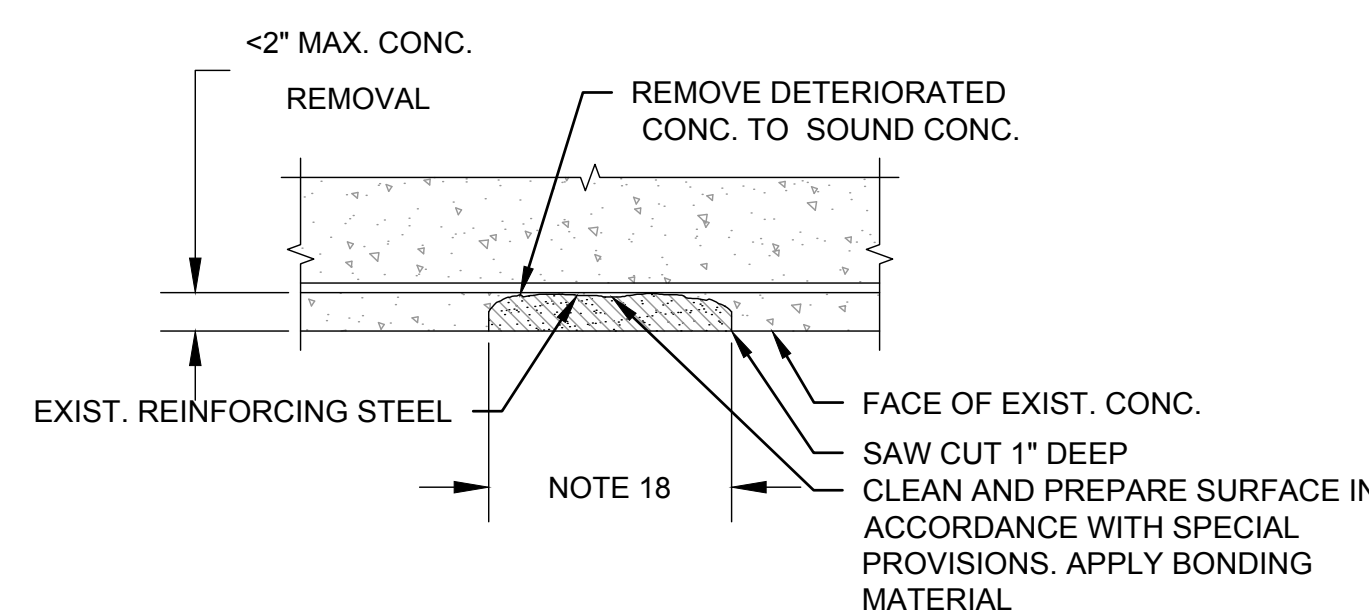
NOTES:

- 1. REMOVE EXISTING MANHOLE FRAMES AND COVERS.
- 2. INSTALL NEW ALUMINUM FLOOR HATCHES WITH 30"x36" CLEAR OPENING, H20 LOAD RATING, FALL THROUGH PROTECTION, AND LOW PROFILE FRAME (4.5" TALL MAX). SEE SPECIFICATION SECTION 08 34 83 FOR ALL HATCH REQUIREMENTS.
- 3. WETWELL REPAIRS AND MODIFICATIONS TO BE PERFORMED ON WETWELL.
- 4. CONTRACTOR TO ASSUME 30 LF OF EPOXY INJECTION REPAIR AND 20 LF OF POLYURETHANE CHEMICAL GROUT REPAIR (TOTAL FOR COMPARISON OF BIDS).



TYPE B (MORE THAN 2" DEEP)

N.T.S.



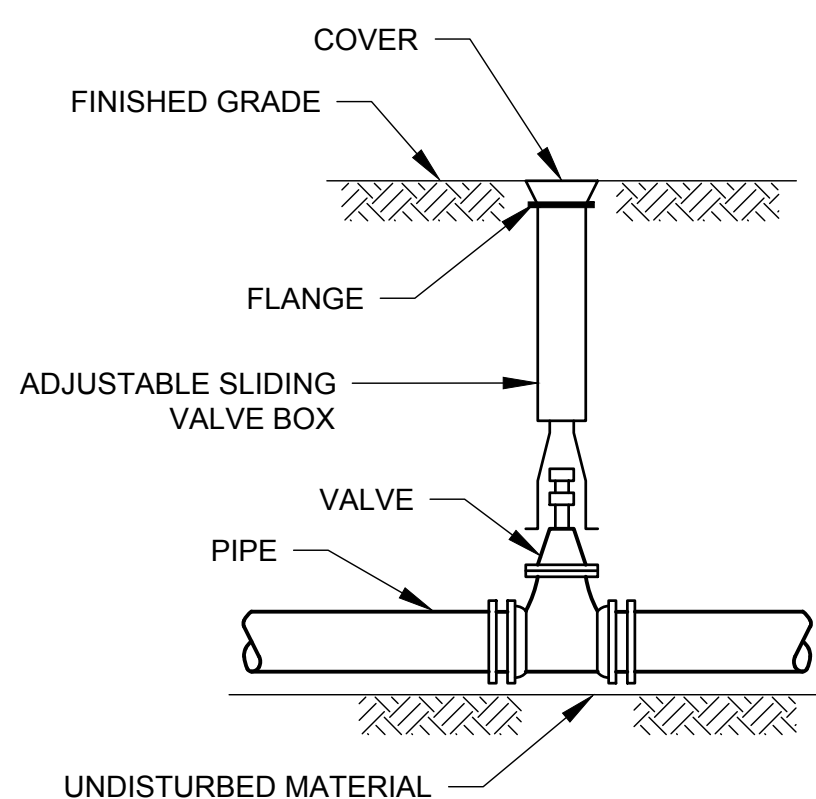
TYPE A (LESS THAN 2" DEEP)

N.T.S.

PARTIAL DEPTH CONCRETE REPAIR DETAILS

NOTES:

- 1. CONTRACTOR TO ASSUME PARTIAL DEPTH CONCRETE REPAIR IS NOT NECESSARY. LIMITS OF CONCRETE REPAIR TO BE DETERMINED BY CONTRACTOR AFTER CLEANING AND INSPECTION OF WETWELL.



VALVE AND BOX DETAIL

N.T.S.

Project:
CITY OF ROCHESTER, NH

LEDGEVIEW SEWER PUMP STATION UPGRADE
54A LEDGEVIEW DRIVE
ROCHESTER, NH 03868

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Portsmouth, NH 03801
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W&S Project No.: ENG23-0367
W&S File No.:

Drawing Title:
CIVIL DETAILS

Sheet Number:
C502

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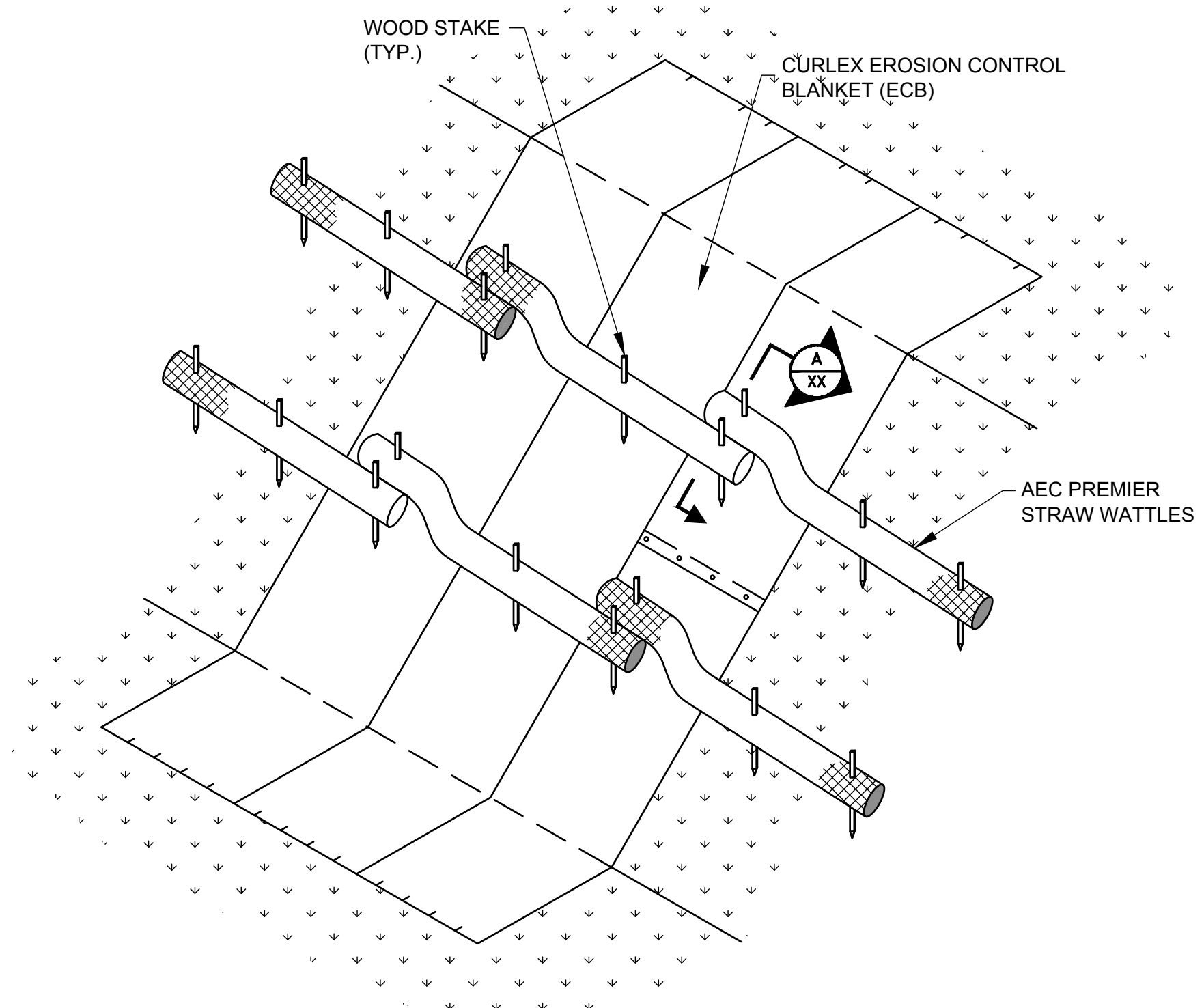
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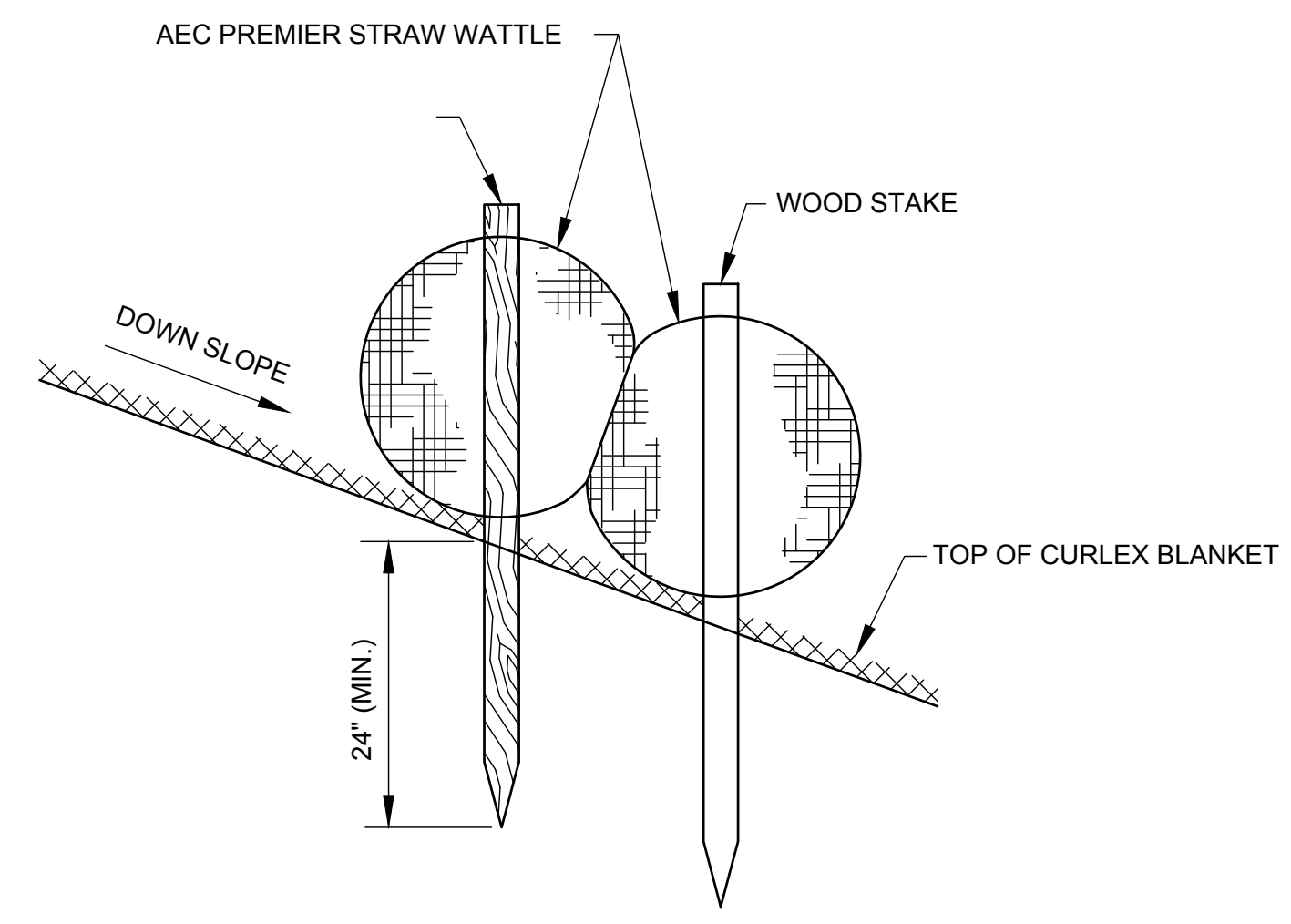
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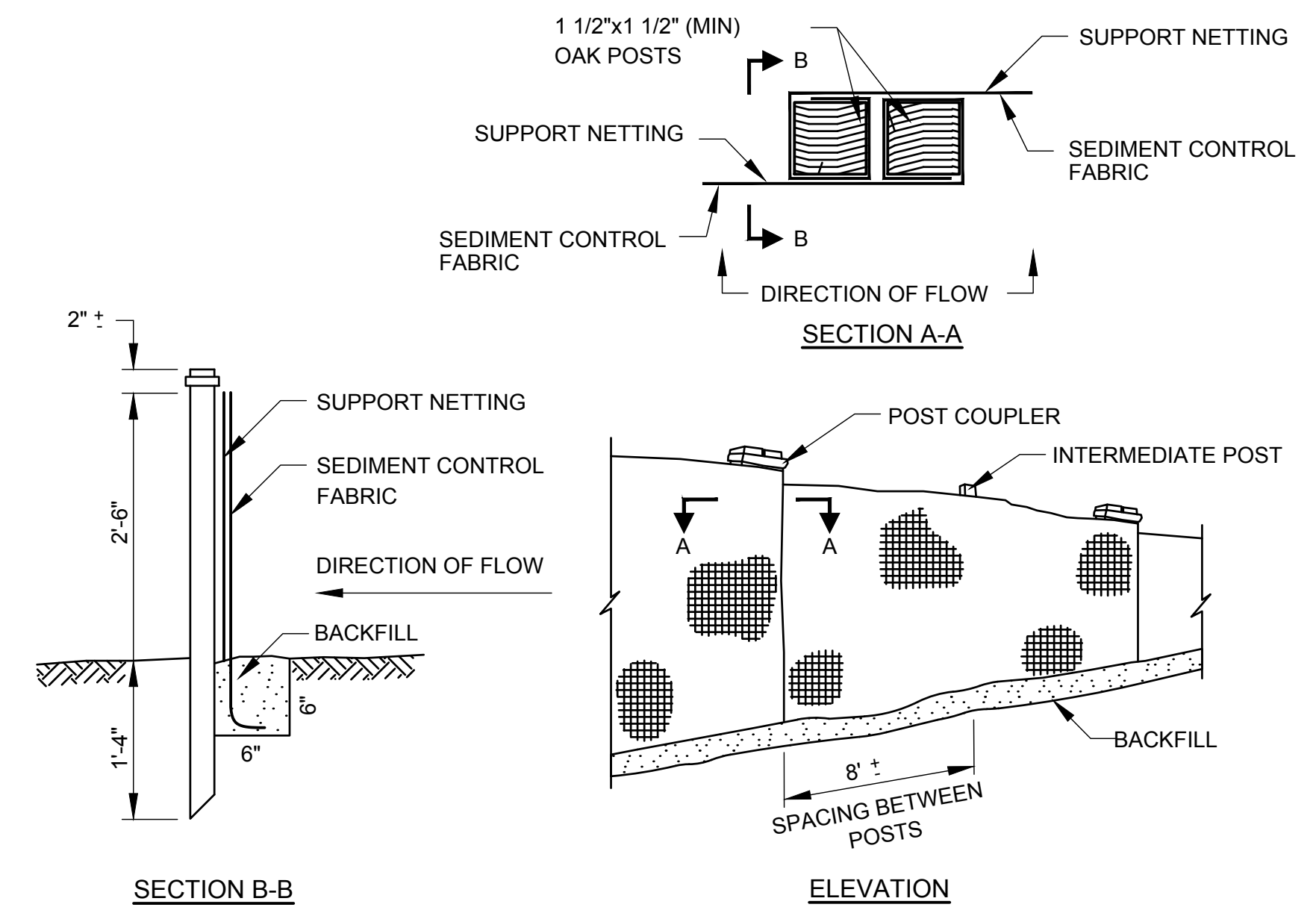
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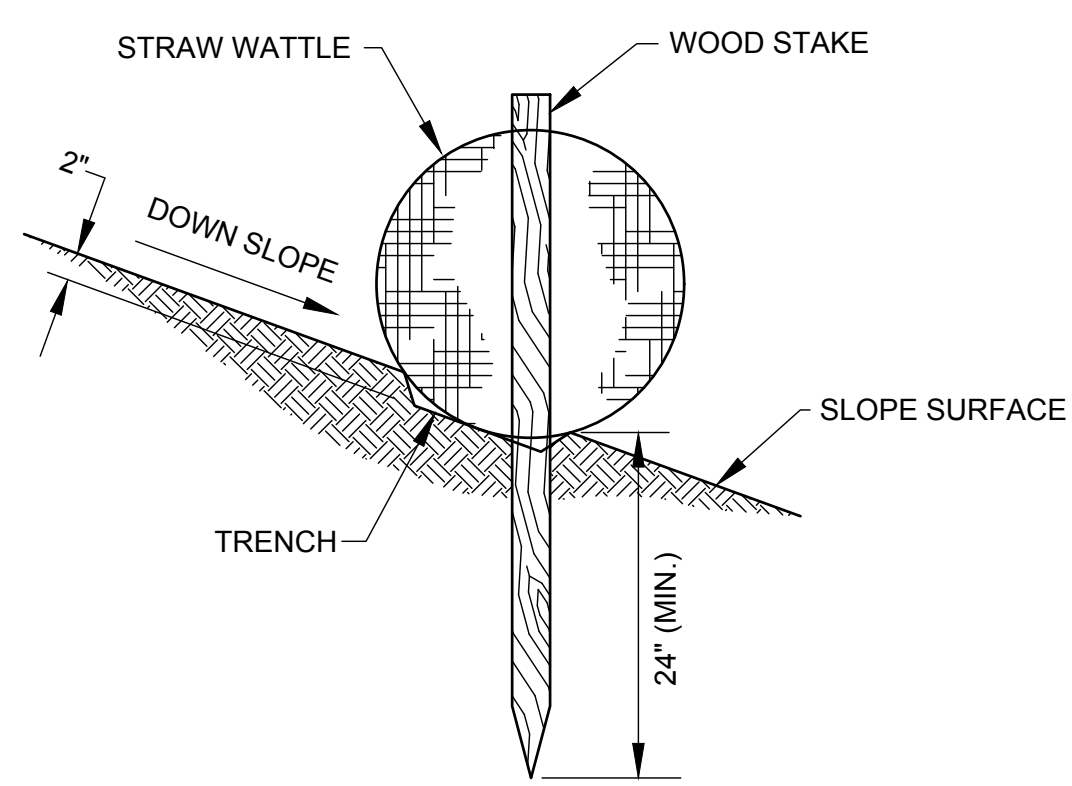
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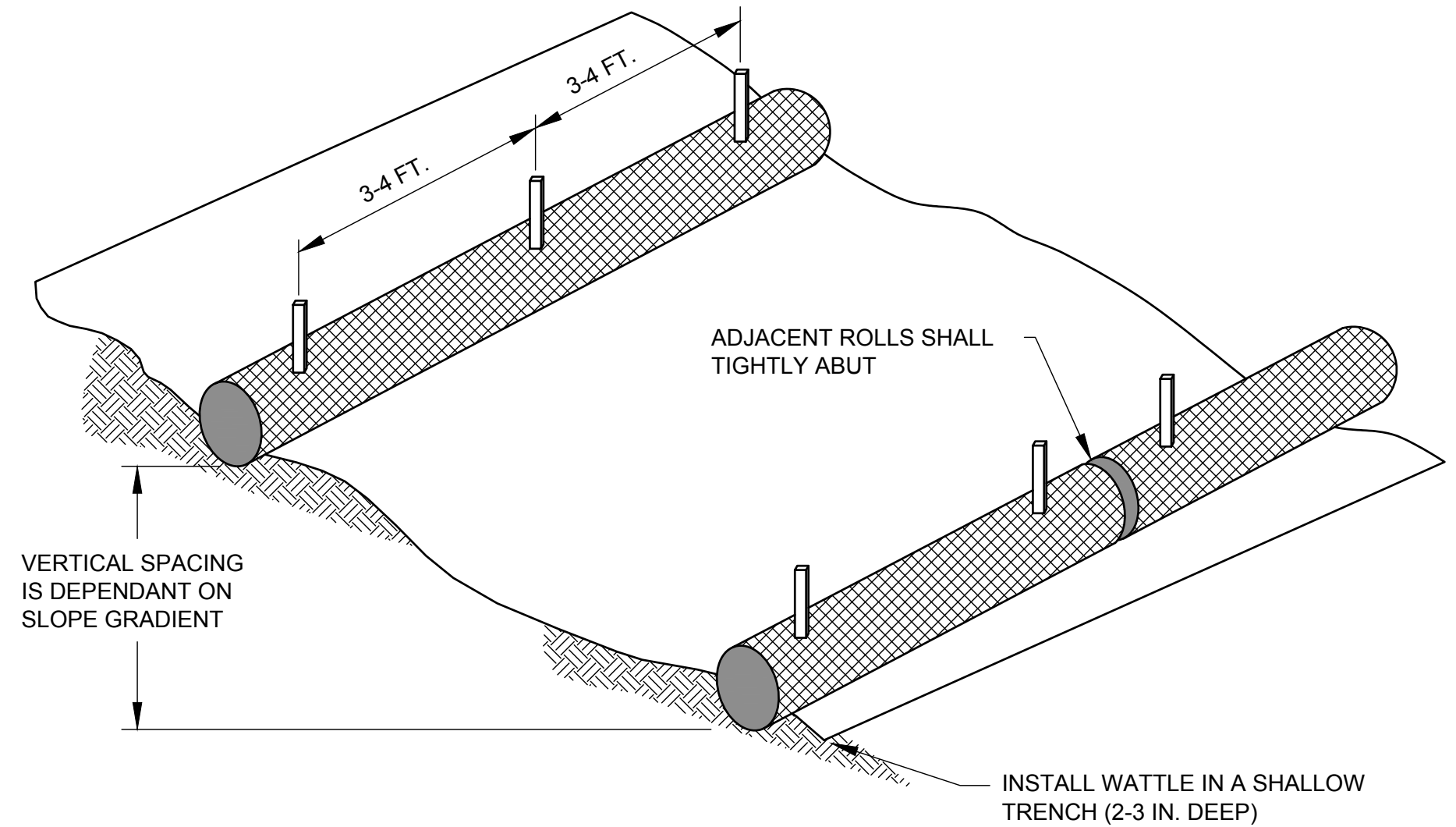
STAKE DETAIL SECTION A-A
 N.T.S.



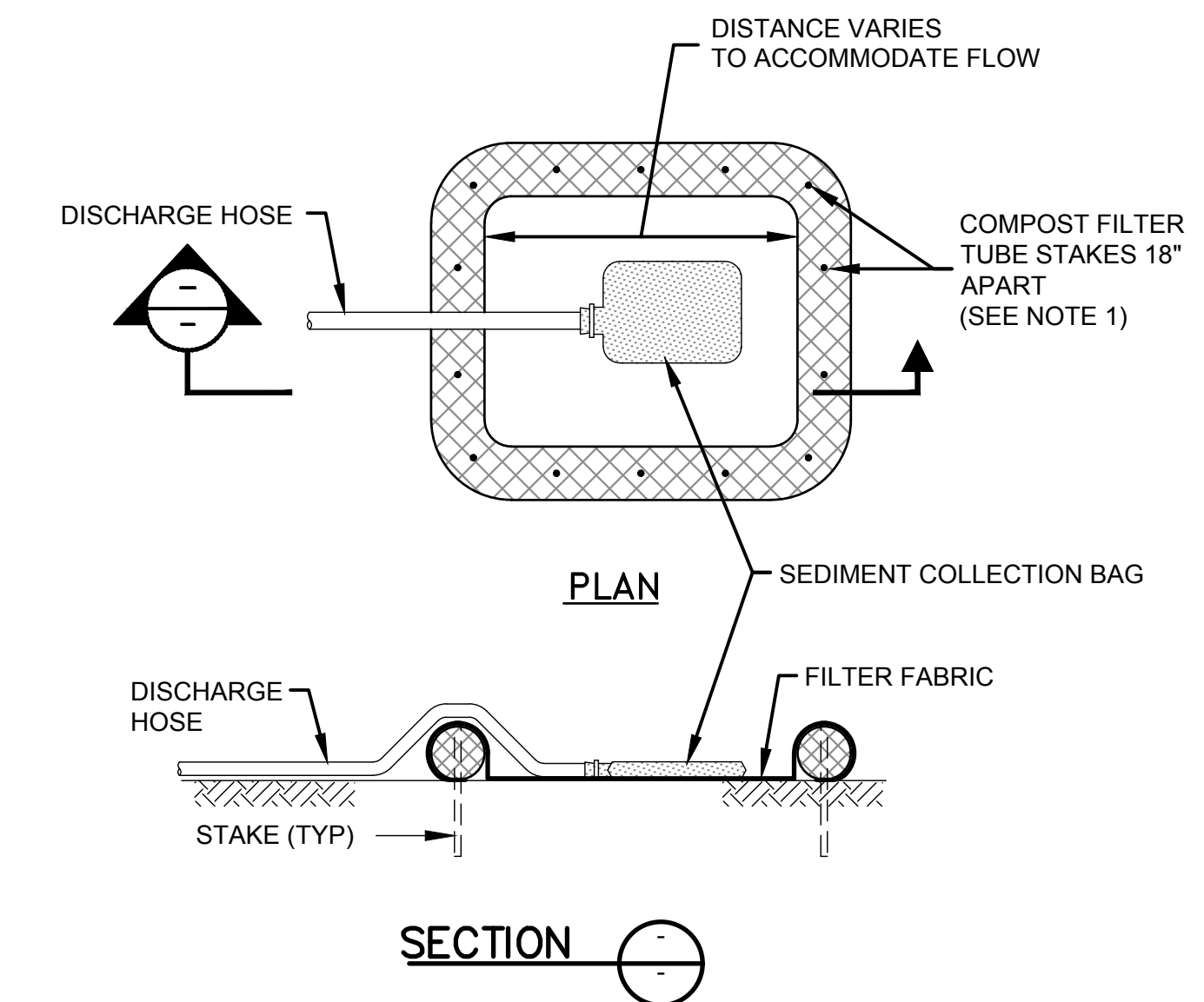
SILT FENCE DETAIL
 N.T.S.



STAKE DETAIL (ON BARE SOIL)
 N.T.S.



STRAW WATTLE INSTALLATION GUIDE
 N.T.S.



DEWATERING DISCHARGE DISPOSAL DETAIL
 N.T.S.

- NOTES:**
- BEGIN AT THE LOCATION WHERE THE WATTLE IS TO BE INSTALLED BY EXCAVATING A 2-3" DEEP X 9" WIDE TRENCH ALONG THE CONTOUR OF THE SLOPE. EXCAVATED SOIL SHOULD BE PLACED UP-SLOPE FROM THE ANCHOR TRENCH.
 - PLACE THE WATTLE IN THE TRENCH SO THAT IT CONTOURS TO THE SOIL SURFACE. COMPACT SOIL FROM THE EXCAVATED TRENCH AGAINST THE WATTLE ON THE UPHILL SIDE. ADJACENT WATTLES SHOULD TIGHTLY ABUT.
 - SECURE THE WATTLE WITH 18-24" STAKES EVERY 3-4' AND WITH A STAKE ON EACH END. STAKES SHOULD BE DRIVEN THROUGH THE MIDDLE OF THE WATTLE LEAVING AT LEAST 2-3" OF STAKE EXTENDING ABOVE THE WATTLE. STAKES SHOULD BE DRIVEN PERPENDICULAR TO SLOPE FACE.

- NOTE:**
- WHEN STAKING IS NOT POSSIBLE, SUCH AS WHEN TUBES MUST BE PLACED ON PAVEMENT, HEAVY CONCRETE OR CINDER BLOCKS CAN BE USED BEHIND TUBES UP TO 5 FT. APART OR AS REQUIRED TO SECURE TUBES IN PLACE.

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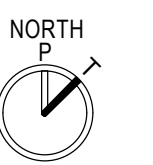
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OVERALL FLOOR PLANS

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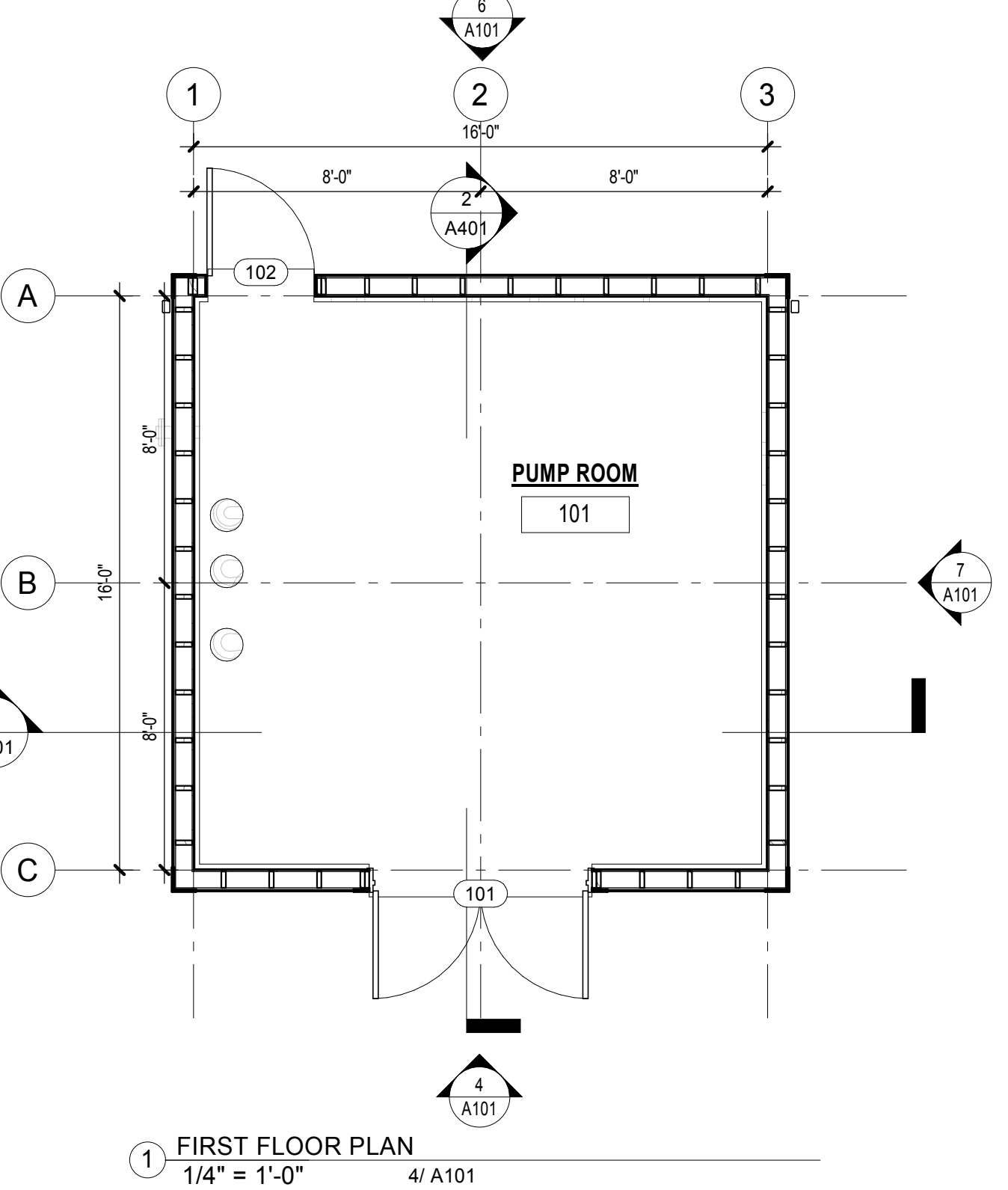
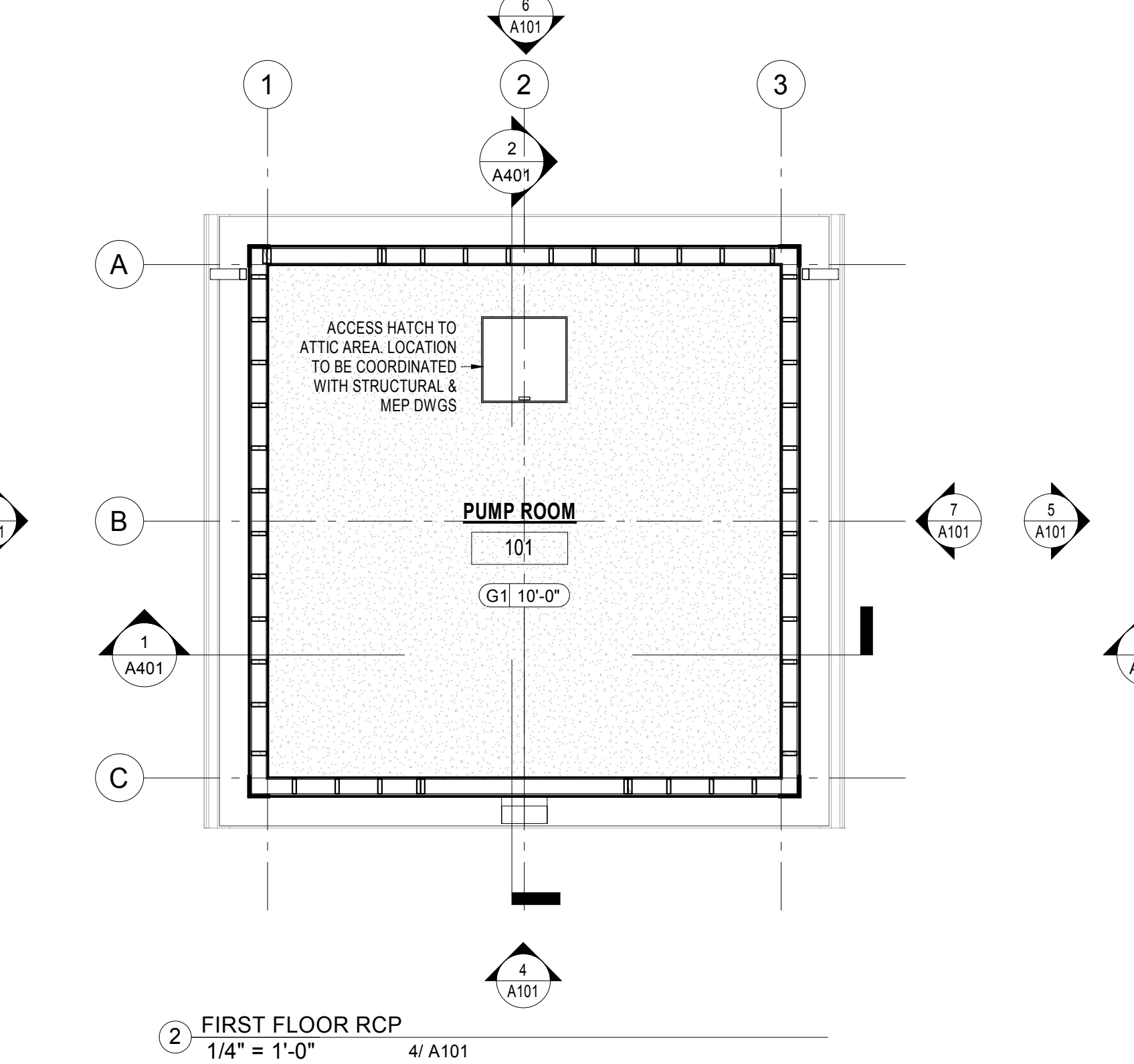
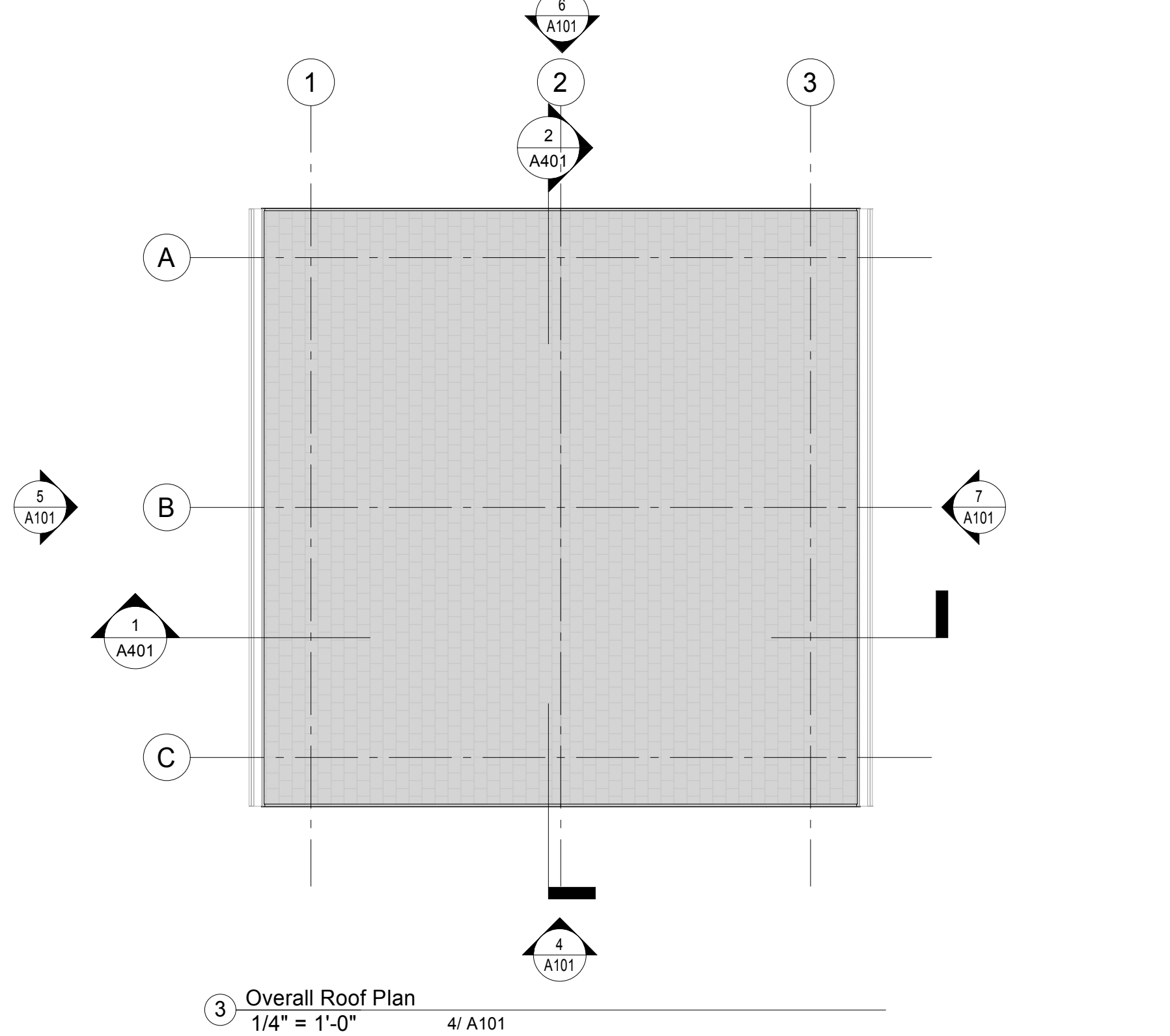
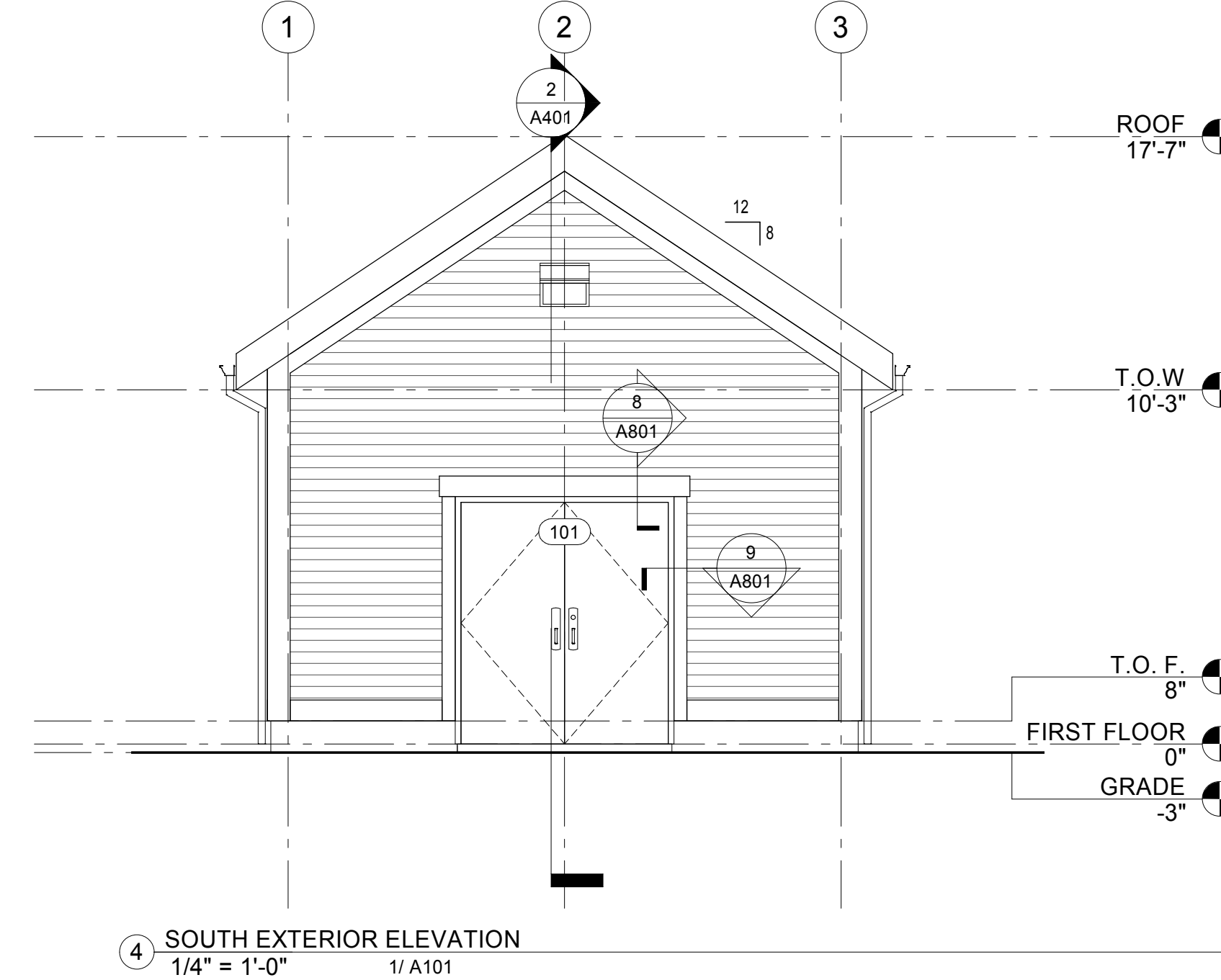
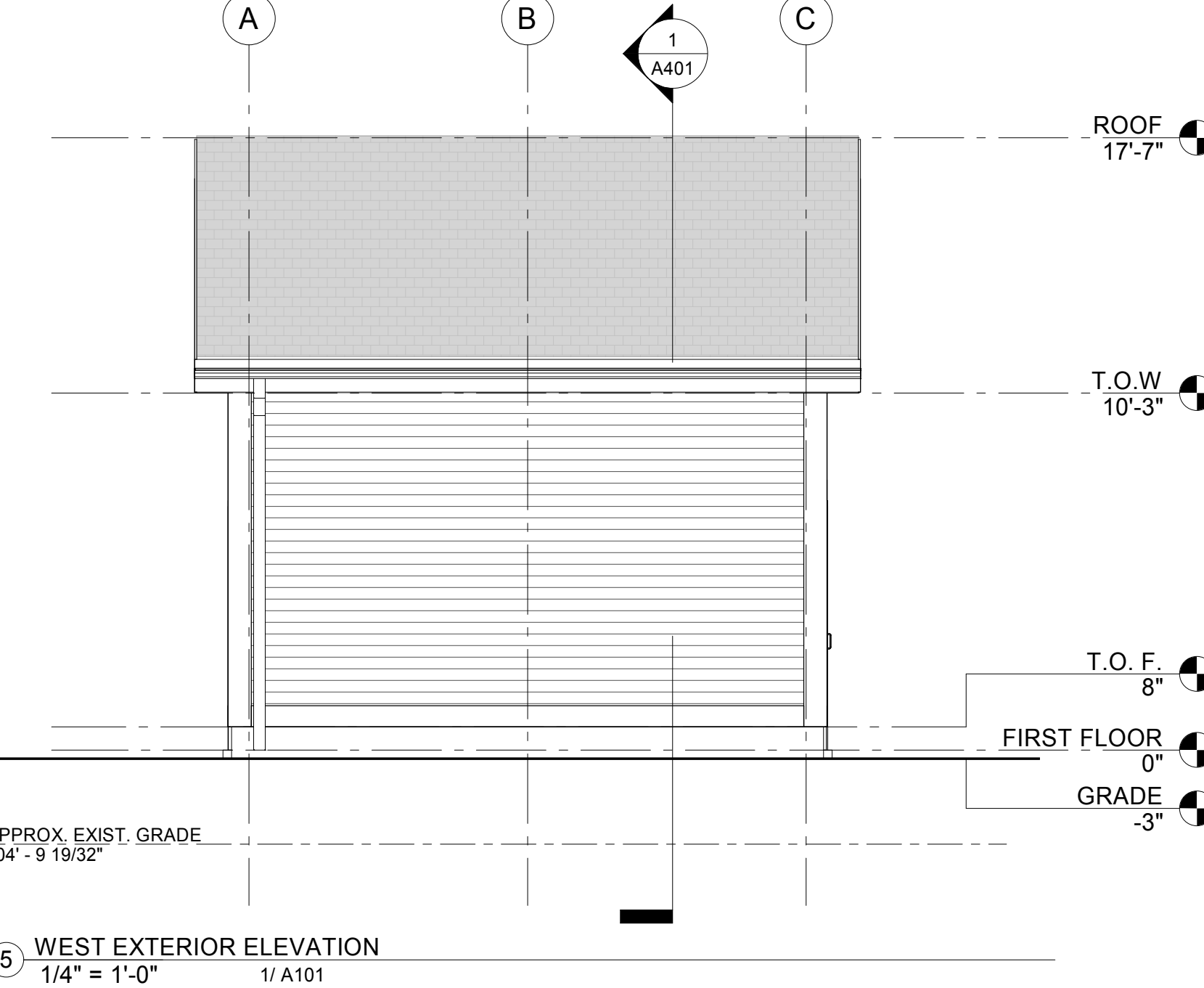
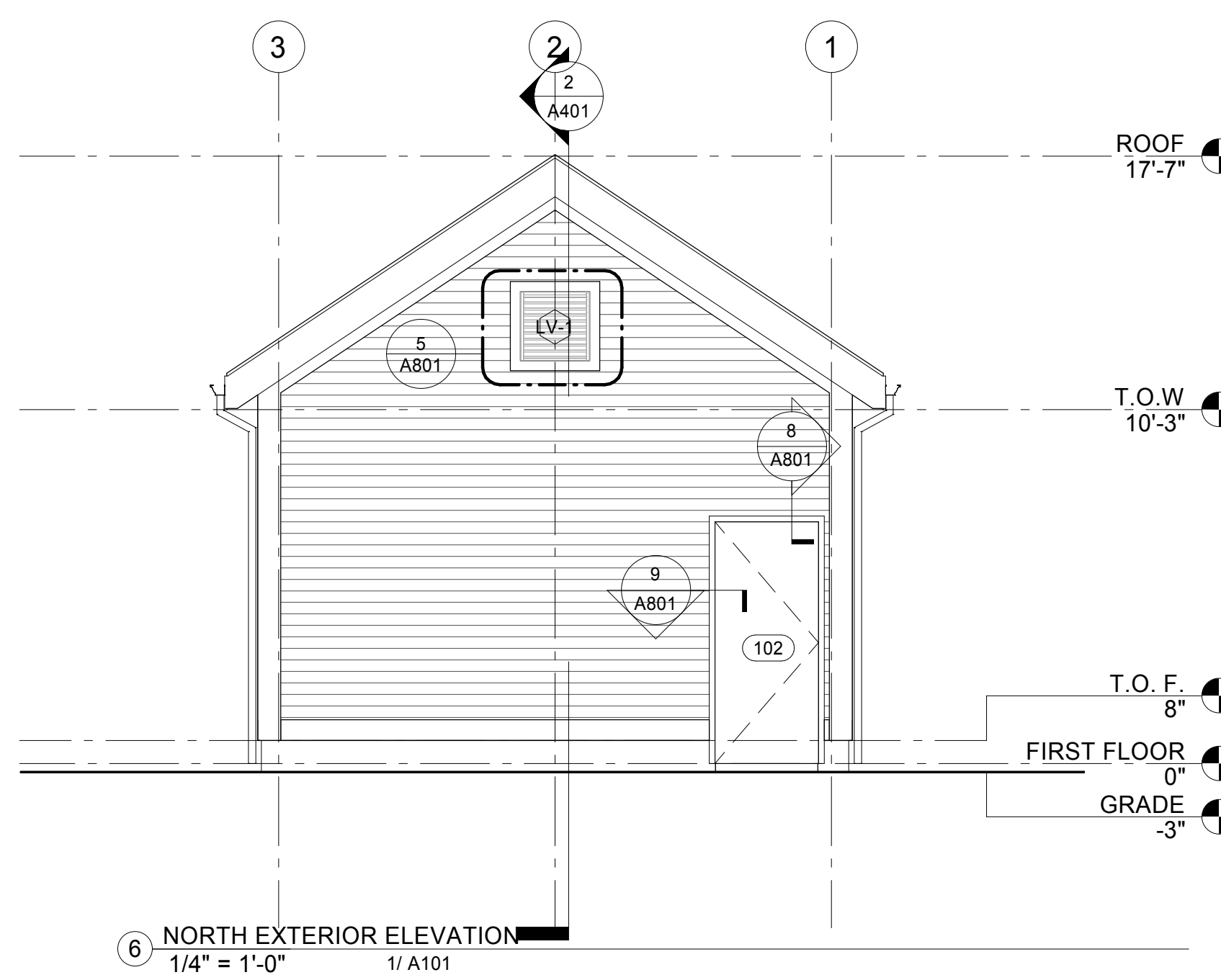
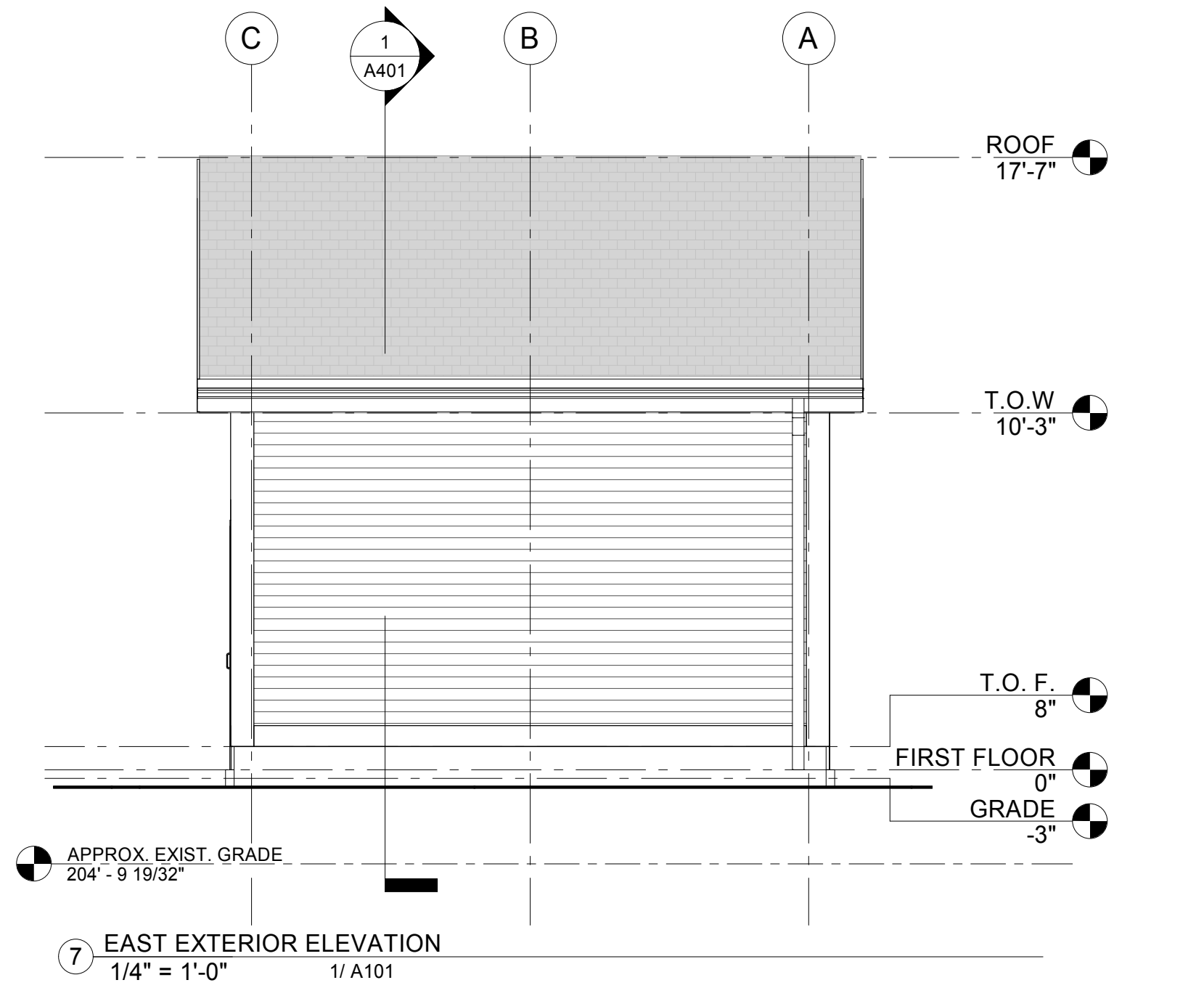
A101

FLOOR PLAN GENERAL NOTES:

- EQUIPMENT SHOWN FOR REFERENCE ONLY. SEE EQ DRAWINGS FOR MORE INFO.
- FURNITURE SHOWN FOR INFORMATION ONLY (N.I.C.). SEE FURNITURE PLAN A921 FOR MORE INFO.
- F.E. = FIRE EXTINGUISHER.
F.E.C = FIRE EXTINGUISHER CABINET
 - BRACKET MOUNTED
 - CABINET MOUNTED (SEMI-RECESSED) 1 / A801
- ALL INTERIOR DIMENSIONS ARE TAKEN FROM FACE OF GYPSUM WALL BOARD TO FACE OF GYPSUM WALL BOARD OR FACE OF CMU UNLESS SPECIFICALLY NOTED OTHERWISE.
- SEE SHEET A012 FOR PLUMBING FIXTURE SCHEDULE / MOUNTING HEIGHTS.
- BOLLARDS:
 - EB: EXTERIOR BOLLARD, 6" DIAMETER (SEE CIVIL DWGS)
- FUME SEPARATION PARTITION. SEE A031 - FUME SEPARATION ASSEMBLY, TYPE F1 AND F2.
- BOX-OUT DIMENSIONS AT STRUCTURAL COLUMNS ARE APPROXIMATE. GENERAL CONTRACTOR TO INSTALL TIGHT TO STRUCTURE, TYPICAL.
- NOT ALL TV / MONITOR LOCATIONS ARE SHOWN. COORDINATE PROPOSED LOCATIONS WITH ELECTRICAL & TELECOMMUNICATIONS DRAWINGS. PROVIDE BLOCKING AT EACH LOCATION ACCORDINGLY.
- CG CORNER GUARD, SEE A901 FOR LOCATIONS.

GENERAL ROOF NOTES - MEMBRANE

- CONCEPTUAL TAPERED INSULATION LAYOUT TO PROVIDE MINIMUM INSULATION HEIGHTS AT ROOF TO WALL AND PERIMETER LOCATIONS. SPECIFIC TAPERED LAYOUT TO BE DEVELOPED BY CONTRACTOR IN CONJUNCTION WITH INSULATION SUPPLIER.
- ADJUSTMENTS TO WOOD BLOCKING HEIGHTS AND CONFIGURATIONS OF FLASHINGS TO CONFORM TO TAPERED INSULATION LAYOUT IS THE RESPONSIBILITY OF THE CONTRACTOR. NO ADDITIONAL COSTS WILL BE ALLOWED TO THE CONTRACTOR IF PROPOSED DETAIL CONFIGURATIONS ARE ALTERED.
- CONTRACTOR TO PERFORM PULL TESTS ON EACH SUBSTRATE PRIOR TO INSTALLING ROOFING MATERIAL / ASSEMBLY.
- CONTRACTOR TO CONFIRM HEIGHT OF ALL WOOD BLOCKING TO ACCOMMODATE THE HEIGHT OF THE ROOF INSULATION.
- CONTRACTOR TO CONDUCT ADHESION TESTING OF ALL SEALANTS.
- CONTRACTOR TO PERFORM WATER TESTS AT ROOF DRAINS AT THE COMPLETION OF ROOF REPLACEMENT.



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Scale: NTS

Key Plan:

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Date: 03/01/2024
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 Reviewed By: Checker
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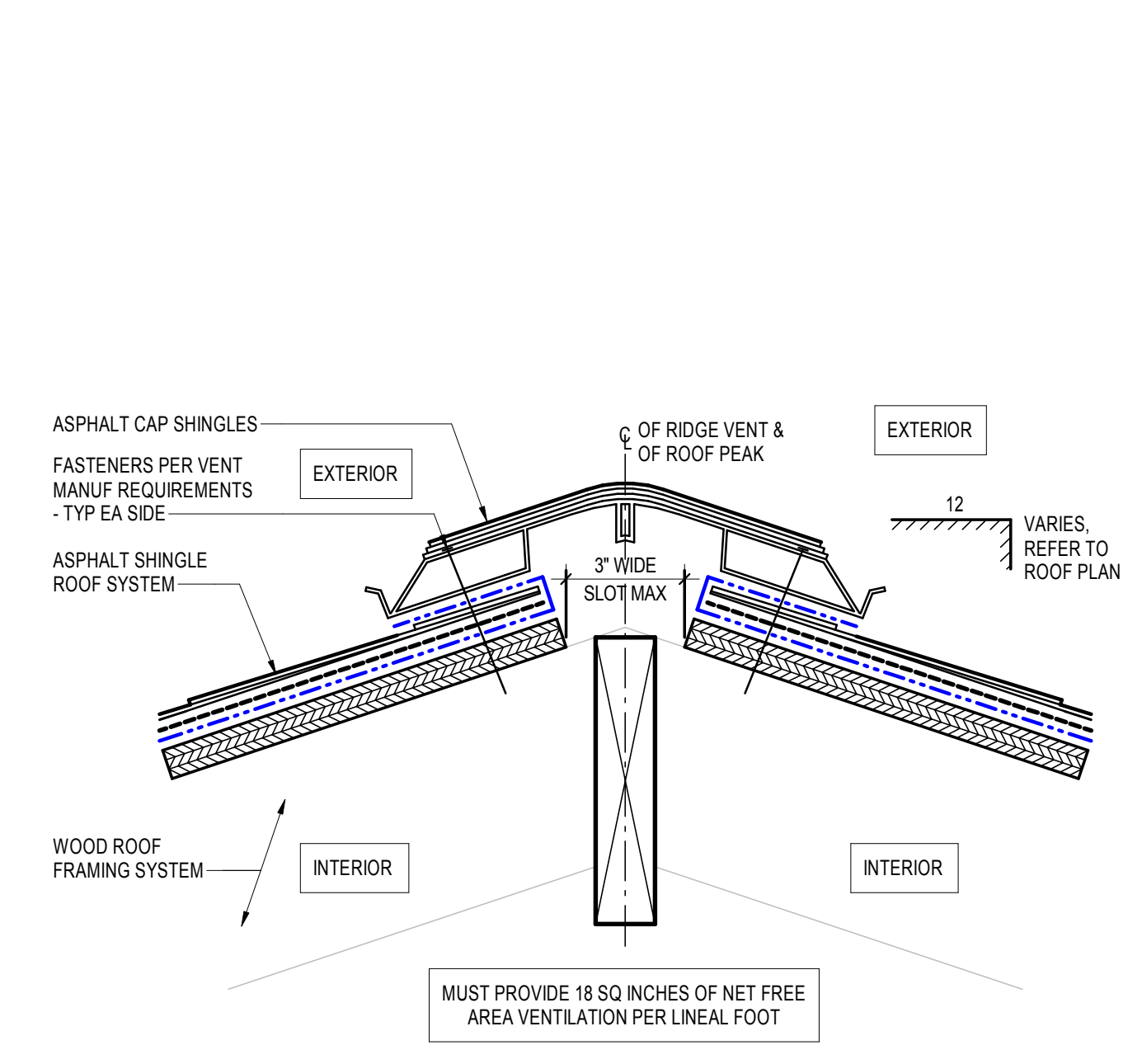
**BUILDING SECTIONS,
WALL SECTIONS &
DETAILS**

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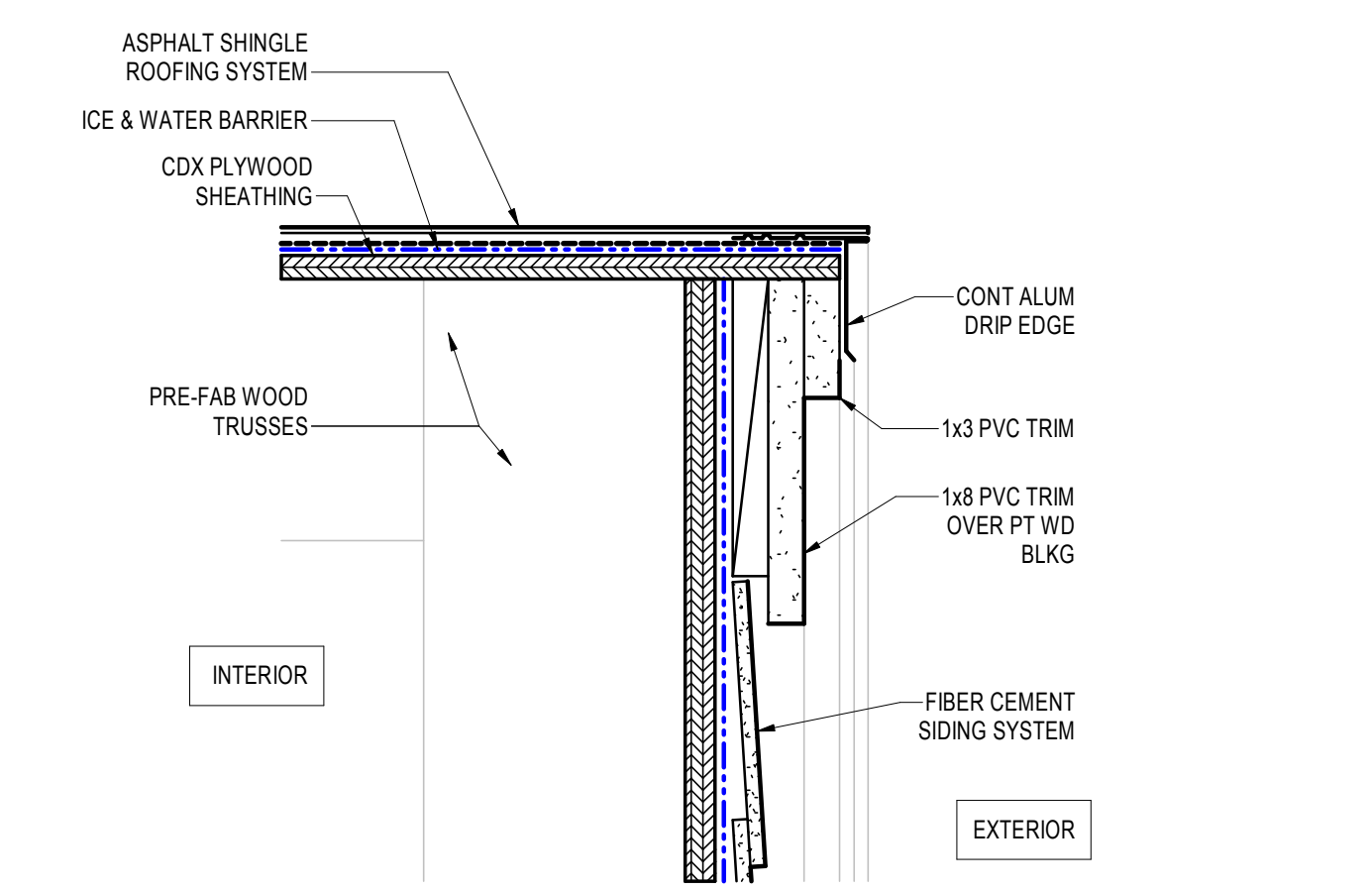
A401

TYPICAL WALL SECTION NOTES

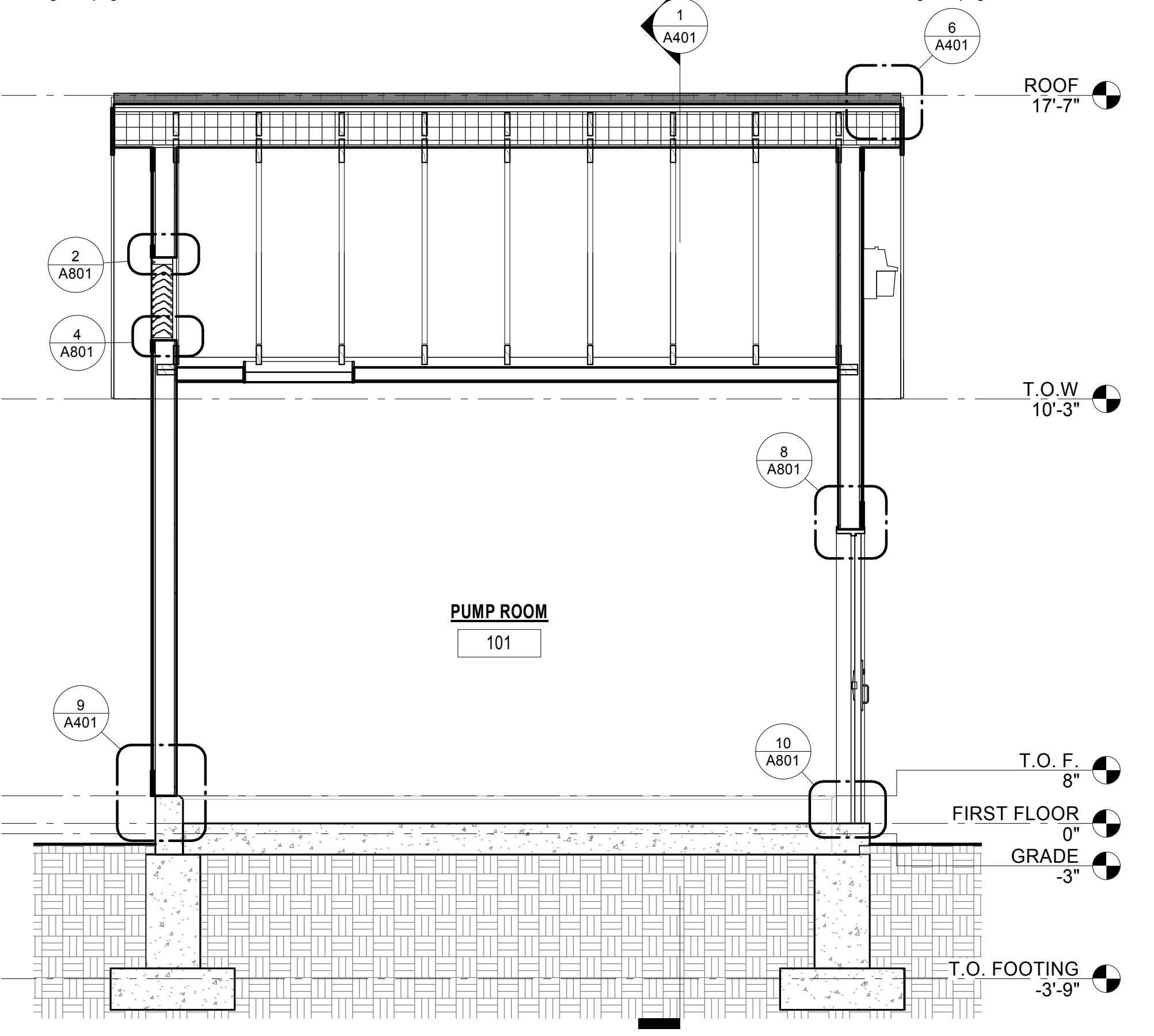
- GIRT SPACING IS SHOWN DIAGRAMMATICALLY ONLY. ACTUAL SPACING WILL BE BY MBM.
- AVB SHALL BE SEALED TO ALL ROOF FABRIC AND ANY STRUCTURE OR SYSTEMS WHICH PASSES THRU THE PLANE OF THE AVB TO FORM A CONTINUOUS AIR VAPOR BARRIER BETWEEN SPACES. TYP.
- SEE A031 FOR WALL AND ROOF ASSEMBLY TYPES



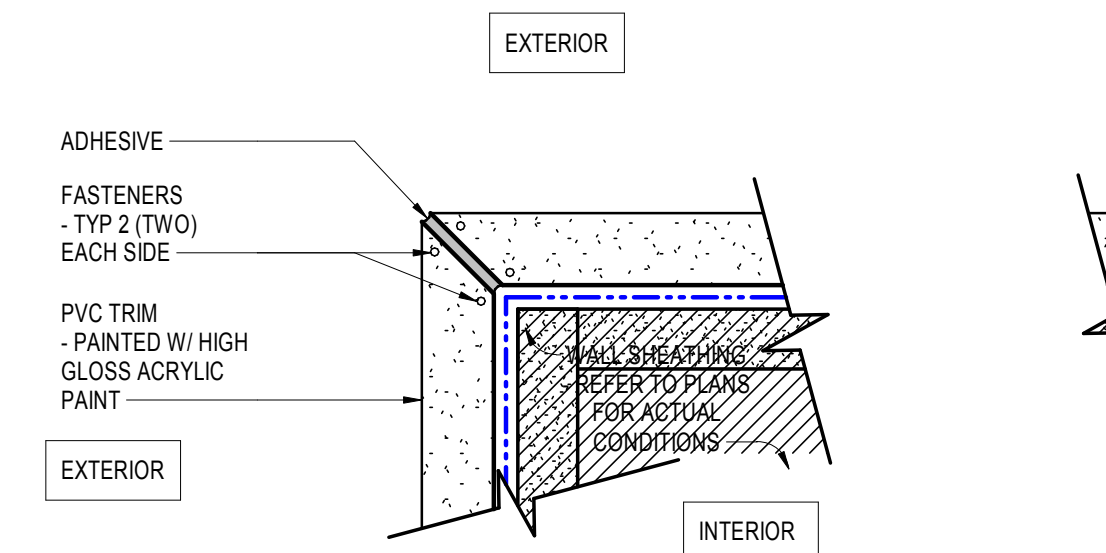
7 RIDGE VENT
3" = 1'-0" 1/ A401



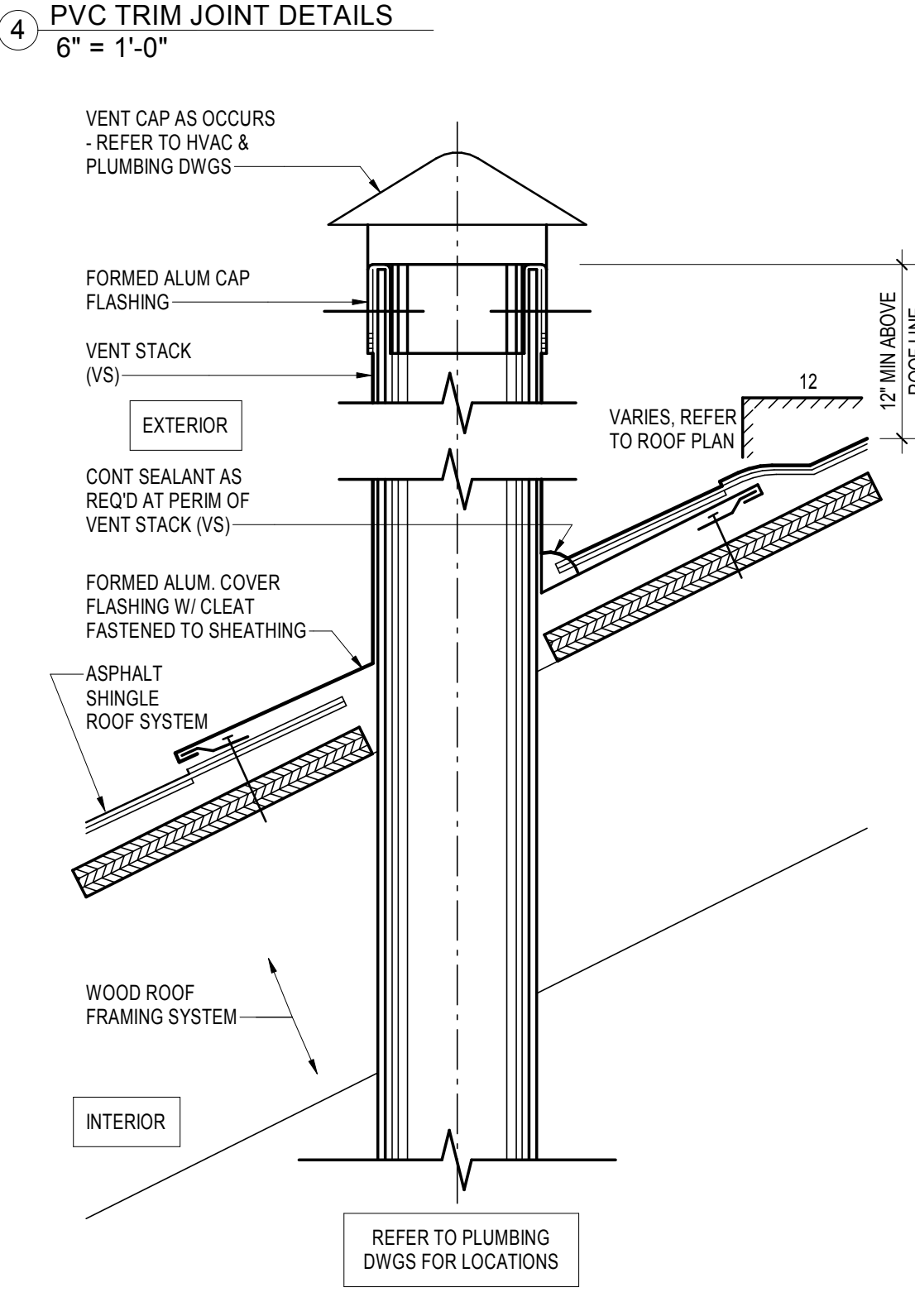
6 RAKE DETAIL
3" = 1'-0" 2/ A401



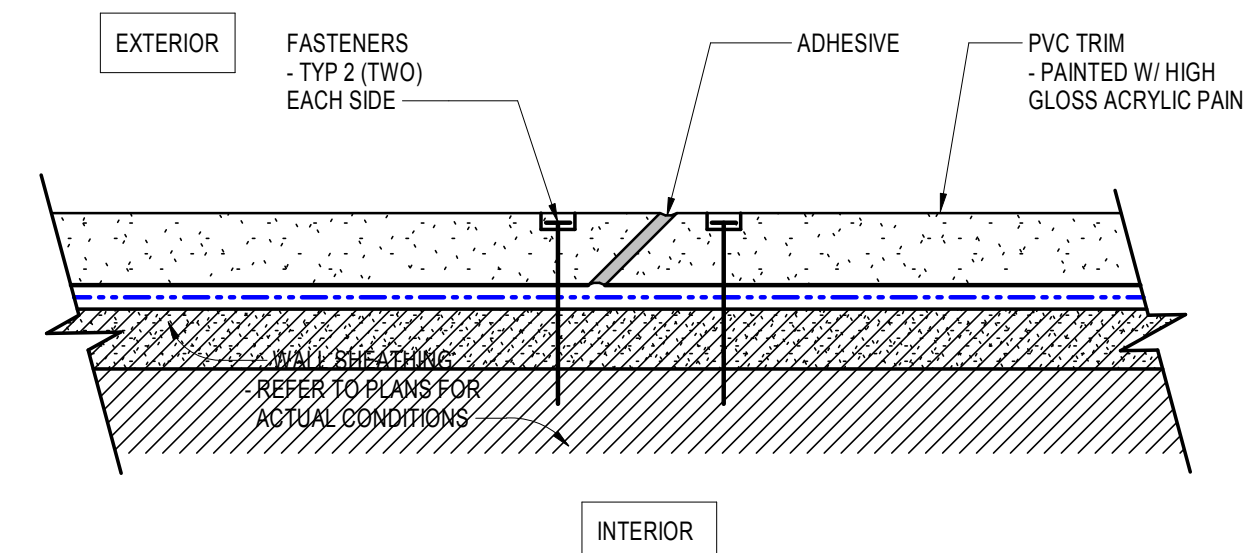
2 SECTION 2
3/8" = 1'-0" 1/ A401



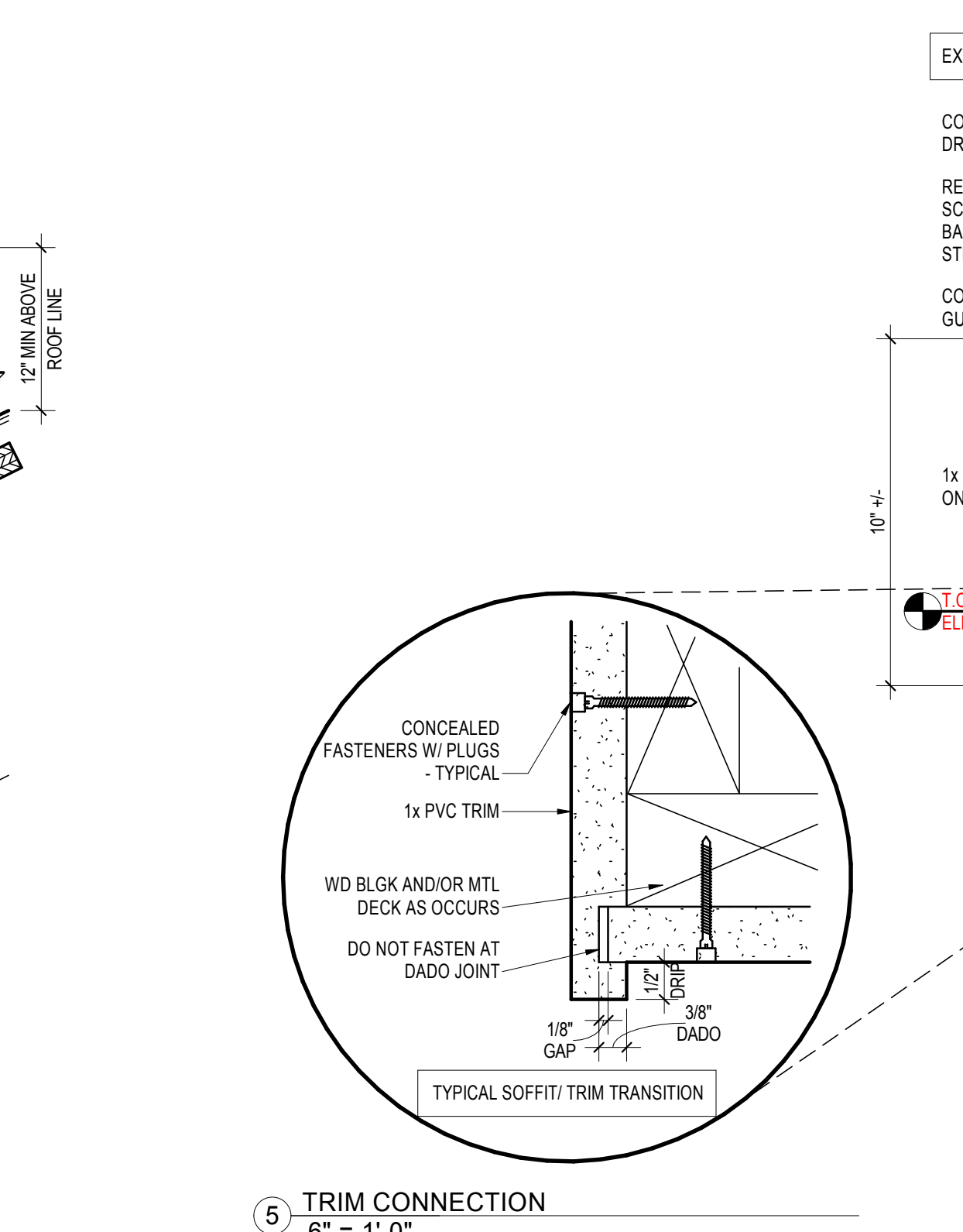
4 PVC TRIM JOINT DETAILS
6" = 1'-0"



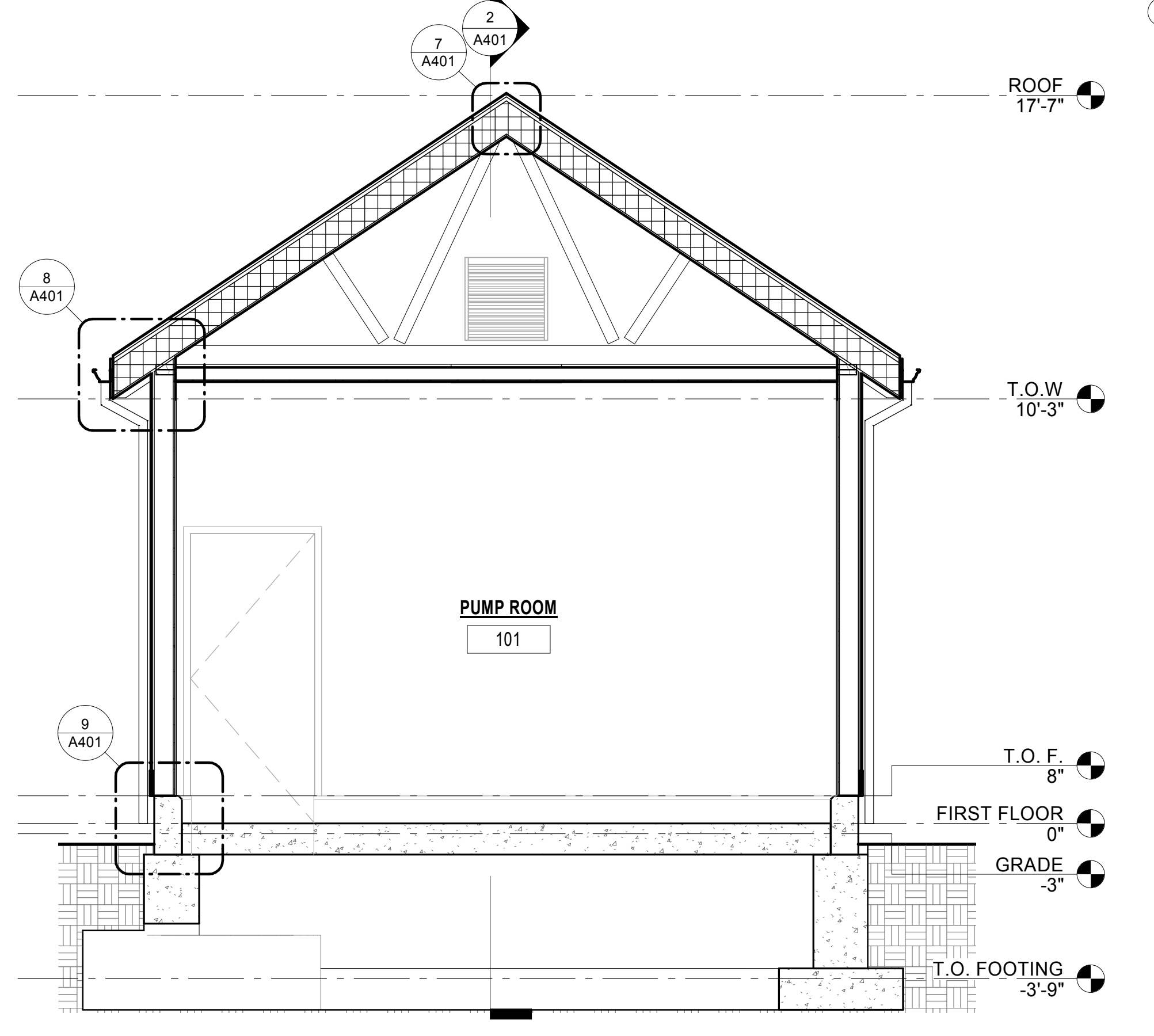
3 VENT STACK
3" = 1'-0" 6 A401



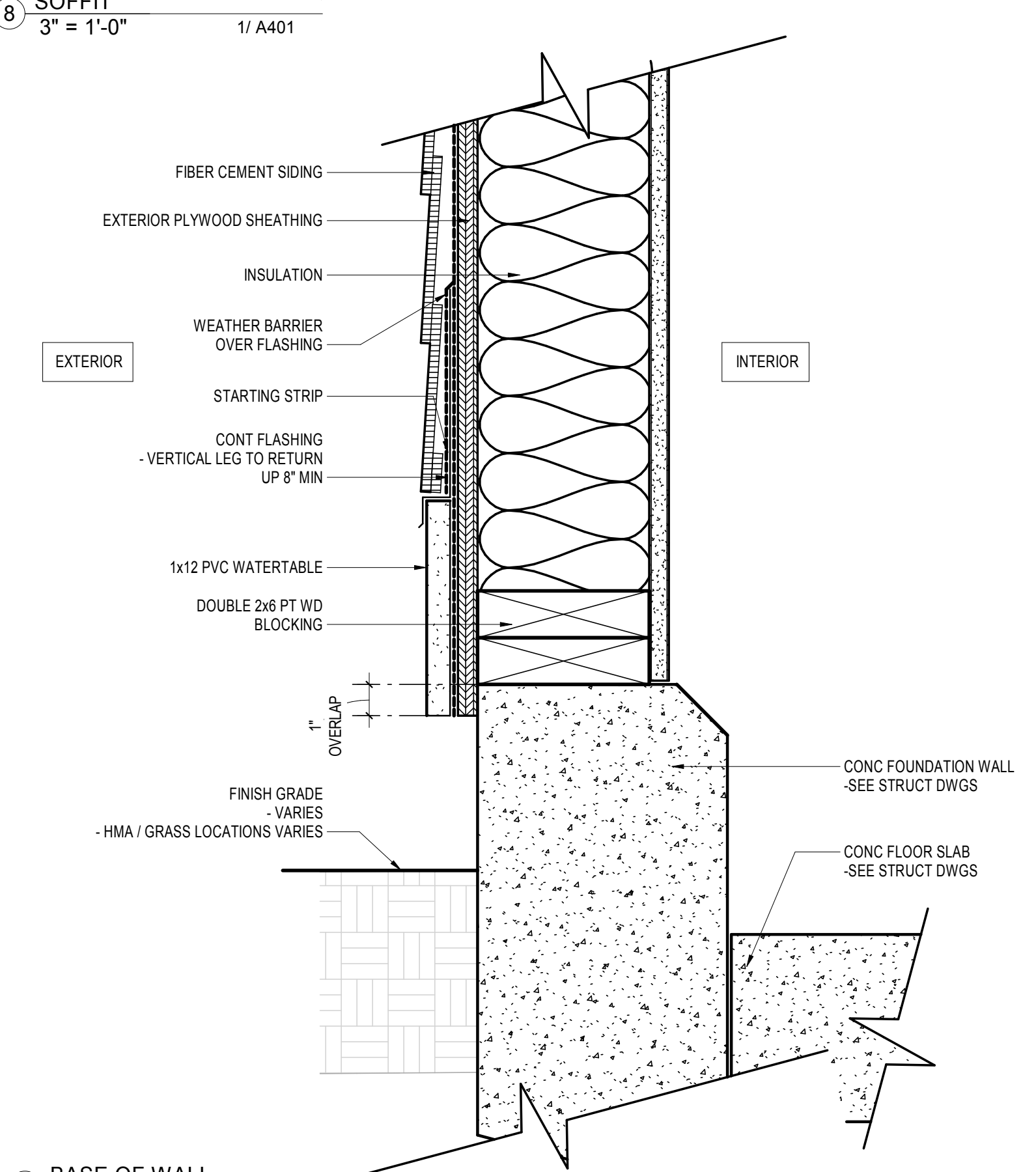
5 TRIM CONNECTION
6" = 1'-0"



8 SOFFIT
3" = 1'-0" 1/ A401



1 SECTION 1
3/8" = 1'-0" 1/ A401



9 BASE OF WALL
3" = 1'-0" 1/ A401

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Attachment B

Boring Logs

GUIDE TO SUBSURFACE EXPLORATION LOGS



INDEX SHEET 1 GENERAL INFORMATION

GENERAL NOTES AND USE OF LOGS

- 1.) Explorations were made by ordinary and conventional methods and with care adequate for Weston & Sampson's study and/or design purposes. The exploration logs are part of a specific report prepared by Weston & Sampson for the referenced project and client, and are an integral part of that report. Information and interpretations are subject to the explanations and limitations stated in the report. Weston & Sampson is not responsible for any interpretations, assumptions, projections, or interpolations made by others.
- 2.) Exploration logs represent general conditions observed at the point of exploration on the date(s) stated. Boundary lines separating soil and rock layers (strata) represent approximate boundaries only and are shown as solid lines where observed and dashed lines where inferred based on drilling action. Actual transitions may be gradual and changes may occur over time.
- 3.) Soil and rock descriptions are based on visual-manual examination of recovered samples, direct observation in test pits (when permissible), and laboratory testing (when conducted).
- 4.) Water level observations were made at the times and under the conditions stated. Fluctuations should be expected to vary with seasons and other factors. Use of fluids during drilling may affect water level observations. The absence of water level observations does not necessarily mean the exploration was dry or that subsurface water will not be encountered during construction.
- 5.) Standard split spoon samplers may not recover particles with any dimension larger than 1-3/8 inches. Reported gravel conditions or poor sample recovery may not reflect actual in-situ conditions.
- 6.) Sections of this guide provide a general overview of Weston & Sampson's practices and procedures for *identifying* and *describing* soil and rock. These procedures are predominantly based on ASTM D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)*, the International Society of Rock Mechanics (ISRM) standards, and the *Engineering Geology Field Manual* published by the Bureau of Reclamation. Not all aspects of this guide relating to description and identification procedures of soil and rock may be applicable in all circumstances.

SAMPLER GRAPHICS

- Split Spoon (Standard)
2" OD, 1-3/8" ID
- Split Spoon (Oversize)
3" OD, 2-3/8" ID
- Shelby or Piston Tube
3" OD, 2-7/8" ID
- Double-Tube Rock Core Barrel
2" Core Diameter
- Direct Push with Acetate Liner
Various Liner Sizes
- Auger Sample
(from cuttings or hand auger)
- Grab Sample
(manual, from discrete point)
- Composite Sample
(multiple grab samples)

WELL GRAPHICS

- Cement concrete seal around casing or riser pipe
- Bentonite seal around casing or riser pipe
- Cement grout seal around casing or riser pipe
- Soil backfill around riser pipe or beneath screen
- Gravel backfill around screen or riser pipe
- Sand backfill around screen or riser pipe (filter sand)
- Solid-wall riser; Sch. 40 PVC, 1" ID unless noted otherwise
- Slotted screen; Sch. 40 PVC, 1" ID with machined slots

CAVING / SEEPAGE TERMS

The following caving and/or seepage terms may appear on a test pit log.

Caving Term	Criteria
Minor.....	less than 1 cubic ft.
Moderate.....	1 to 3 cubic ft.
Severe.....	greater than 3 cubic ft.
Seepage Term	Criteria
Slow.....	less than 1 gpm
Moderate.....	1 to 3 gpm
Fast.....	greater than 3 gpm

KEY TO WATER LEVELS

- Observed in exploration during advancement.
- Measured in exploration at completion, prior to backfilling or well installation.
- Measured in exploration after the stated stabilization period, prior to backfilling, or in well installation if noted.

DEFINITIONS OF COMMON TERMS

Sample Recovery Ratio - The length of material recovered in a drive or push type sampler over the length of sampler penetration, in inches (e.g. 18/24).

Standard Penetration Test (SPT) - An in-situ test where a standard split-spoon sampler is driven a distance of 12 or 18 inches (after an initial 6-inch seating interval) using a 140-lb. hammer falling 30 inches for each blow.

SPT Blows - The number of hammer blows required to drive a split-spoon sampler each consecutive 6-inch interval during a *Standard Penetration Test*. If no discernable advancement of a split spoon sampler is made after 50 consecutive hammer blows, 50/X indicates *sampler refusal* and is the number of blows required to drive the sampler X inches.

SPT N-Value (N) - The uncorrected blow count representation of a soil's penetration resistance over a 12-inch interval after an initial 6-in. seating interval, reported in blows per foot (bpf). The N-value is correlated to soil engineering properties.

Auger Refusal - No discernable advancement of the auger over a period of 5 minutes with full rig down pressure applied.

Casing Refusal (Driven) - Casing penetration of less than 6 inches after a minimum 50 blows of a drop hammer weighing 300 lbs. or a minimum 100 blows of a drop hammer weighing 140 lbs.

PID Measurement - A measurement (electronic reading) taken in the field using a photoionization detector (PID) to detect the presence of volatile organic compounds in a soil sample. Values are reported as benzene equivalent units in parts per million (ppm) unless noted otherwise.

Rock Quality Designation (RQD) - A qualitative index measure of the degree of jointing and fracture of a rock core taken from a borehole. The RQD is defined as the sum length of solid core pieces 4 inches or longer divided by the run (cored) length, expressed as a percentage. Higher RQD values may indicate fewer joints and fractures in the rock mass.

Fill (Made Ground) - A deposit of soil and/or artificial waste materials that has been placed or altered by human processes.

LABORATORY TESTS AND FIELD MEASUREMENTS

MC.....	Moisture Content	IC.....	1D Incremental Consolidation
OC.....	Organic Content	VS.....	Laboratory Vane Shear
PL.....	Plastic Limit	US.....	Unconfined Compression
LL.....	Liquid Limit	TC.....	Triaxial Compression
GC.....	Gravel Content	PP.....	Pocket (Hand) Penetrometer
SC.....	Sand Content	TV.....	Torvane (Hand Vane)
FC.....	Fines Content	PID.....	Photoionization Detector
DS.....	Direct Shear	FID.....	Flame Ionization Detector

BORING ADVANCEMENT METHODS

Hollow-Stem Auger Drilling - Utilizes continuous flight auger sections with hollow stems to advance the borehole. Drill rods and a plug are inserted into the auger stem to prevent the entrance of soil cuttings into the augers.

Rotary Wash Drilling - Utilizes downward pressure and rotary action applied to a non-coring bit while washing the cuttings to the surface using a circulating fluid injected down the drill rods. The borehole is supported with either steel casing or the drilling fluid. Where a casing is used, the borehole is advanced sequentially by driving the casing to the desired depth and then cleaning out the casing. The process of driving and cleaning the casing is commonly referred to as the 'drive-and-wash' technique.

Continuous Sampling - Includes a variety of methods and procedures during which the borehole is advanced via continuous recovery of soil samples. *Direct Push* sampling is a common method that uses static downward pressure combined with percussive energy to drive a steel mandrel into the ground at continuous intervals while recovering soil samples in disposable acetate liners.

Rock Coring - Utilizes downward pressure and rotary action applied to a core barrel equipped with a diamond-set or tungsten carbide coring bit. During conventional coring, the entire barrel is retrieved from the hole upon completion of a core run. Wireline coring allows for removal of the inner barrel assembly containing the actual core while the drill rods and outer barrel remain in the hole. Various types and sizes of core barrels and bits are used.

GUIDE TO SUBSURFACE EXPLORATION LOGS



INDEX SHEET 2 SOIL DESCRIPTION

SOIL CONSTITUENTS

Naturally occurring soils consist of one or more of the following matrix constituents defined in terms of particle size.

Constituent	U.S. Sieve Size	Observed Size (in.)
Gravel (Coarse)	3/4 in. - 3 in.	3/4 - 3
Gravel (Fine)	No. 4 - 3/4 in.	1/5 - 3/4
Sand (Coarse)	No. 10 - No. 40	1/16 - 1/5
Sand (Medium)	No. 40 - No. 10	1/64 - 1/16
Sand (Fine)	No. 200 - No. 40	1/300 - 1/64
Fines (Silt or Clay)	Smaller than No. 200	Less than 1/300

SOIL IDENTIFICATION

Soil identification refers to the grouping of soils with similar physical characteristics into a category defined by a **group name** and corresponding **group symbol** based on estimation of the matrix soil constituents to the nearest 5% and simple manual tests. Proportions of cobbles, boulders, and other non-matrix soil materials are not considered during this procedure but are included in the overall soil description if observed or thought to be present. Refer to the following descriptions and tables adapted from ASTM D2488.

Coarse-Grained Soil - Coarse-grained soils contain fewer than 50% fines and are identified based on the following table.

Primary Constituent	Fines Percent	Type of Fines and Gradation	Group Symbol	Group Name ⁽¹⁾
GRAVEL	≤ 5%	well graded	GW	Well graded gravel
		poorly graded	GP	Poorly graded gravel
	10%	clayey well graded fines	GW-GC	Well graded gravel with clay fines
		poorly graded silty well graded fines	GP-GC	Poorly graded gravel with clay fines
SAND	15% to 45%	clay fines	GC	Clayey gravel
		silt fines	GM	Silty gravel
	≤ 5%	well graded	SW	Well graded sand
		poorly graded	SP	Poorly graded sand
% sand ≥ % gravel	10%	clayey well graded fines	SW-SC	Well graded sand with clay fines
		poorly graded silty well graded fines	SP-SC	Poorly graded sand with clay fines
	15% to 45%	clay fines	SW-SM	Well graded sand with silt
		silt fines	SP-SM	Poorly graded sand with silt
% sand ≥ % gravel	15% to 45%	clay fines	SC	Clayey sand
		silt fines	SM	Silty sand

⁽¹⁾ If soil is a gravel and contains 15% or more sand, add "with sand" to the group name. If soil is a sand and contains 15% of more gravel, add "with gravel" to the group name.

Inorganic Fine-Grained Soil - Fine-grained soils contain 50% or more fines and are identified based on the following table.

Plasticity Criteria	Dry Strength	Coarse Fraction S = Sand, G = Gravel	Group Symbol	Group Name ⁽¹⁾
Medium	Medium to high	< 15% S + G	CL	Lean clay
		≥ 30% % S ≥ % G	CL	Sandy lean clay
		S + G % S < % G	CL	Gravelly lean clay
Non-plastic	None to low	< 15% S + G	ML	Silt
		≥ 30% % S ≥ % G	ML	Sandy silt
		S + G % S < % G	ML	Gravelly silt
High	High to very high	< 15% S + G	CH	Fat clay
		≥ 30% % S ≥ % G	CH	Sandy fat clay
		S + G % S < % G	CH	Gravelly fat clay
Low to Medium	Low to medium	< 15% S + G	MH	Elastic silt
		≥ 30% % S ≥ % G	MH	Sandy elastic silt
		S + G % S < % G	MH	Gravelly elastic silt

⁽¹⁾ If soil contains 15% to 25% sand or gravel, add "with sand" or "with gravel" to the group name.

Organic Fine-Grained Soil - Fine-grained soils that contain enough organic particles to influence the soil properties are identified as Organic Soil and assigned the group symbol **OL** or **OH**.

Highly Organic Soil (Peat) - Soils composed primarily of plant remains in various stages of decomposition are identified as Peat and given the group symbol **PT**. Peat usually has an organic odor, a dark brown to black color, and a texture ranging from fibrous (original plant structure intact or mostly intact) to amorphous (plant structure decomposed to fine particles).

SOIL DESCRIPTION

Soils are described in the following general sequence. Deviations may occur in some instances.

Identification Components

(1) Group Name and Group Symbol

Description Components

- (2) Consistency (Fine-Grained) or Apparent Density (Coarse-Grained)
- (3) Color (*note, the term "to" may be used to indicate a gradational change*)
- (4) Soil Moisture
- (5) Matrix Soil Constituents (Gravel, Sand, Fines)
 - ↳ Proportion (*by weight*), particle size, plasticity of fines, angularity, etc.
- (6) Non-Matrix Soil Materials and Proportions (*by volume*)
- (7) Other Descriptive Information (Unusual Odor, Structure, Texture, etc.)
- (8) [Geologic Formation Name or Soil Survey Unit]

SPT N-VALUE CORRELATIONS

Consistency	SPT N-Value	Apparent Density	SPT N-Value
Very soft	0 - 2	Very loose	0 - 5
Soft	2 - 4	Loose	5 - 10
Medium stiff	4 - 8	Medium dense	10 - 30
Stiff	8 - 15	Dense	30 - 50
Very stiff	15 - 30	Very dense	> 50
Hard	> 30		

SOIL MOISTURE

Dry..... Apparent absence of moisture; dry to the touch.
Moist..... Damp but no visible water.
Wet..... Visible free water; saturated.

PROPORTIONS / PERCENTAGES

Proportions of gravel, sand, and fines (excluding cobbles, boulders, and other constituents) are stated in the following terms indicating a range of percentages by weight (to nearest 5%) of the minus 3-in. soil fraction and add up to 100%.

Proportions of cobbles, boulders, and other non-matrix soil materials including artificial debris, roots, plant fibers, etc. are stated in the following terms indicating a range of percentages by volume (to the nearest 5%) of the total soil.

Mostly 50% - 100%	Numerous 40% - 50%
Some 30% - 45%	Common 25% - 35%
Little 15% - 25%	Occasional 10% - 20%
Few 5% - 10%	Trace Less than 5%
Trace Less than 5%	

PLASTICITY (FINES ONLY)

Non-plastic..... Dry specimen ball falls apart easily. Cannot be rolled into thread at any moisture content.
Low..... Dry specimen ball easily crushed with fingers. Can be rolled into 1/8-in. thread with some difficulty.
Medium..... Difficult to crush dry specimen ball with fingers. Easily rolled into 1/8-in. thread.
High..... Cannot crush dry specimen ball with fingers. Easily rolled and re-rolled into 1/8-in. thread.

COBBLES AND BOULDERS

Cobbles - Particles of rock that will pass a 12-in. square opening and be retained on a 3-in. sieve.
Boulders - Particles of rock that will not pass a 12-in. square opening.

Note: Where the percentage (by volume) of cobbles and/or boulders cannot be accurately or reliably estimated, the terms "with cobbles", "with boulders", or "with cobbles and boulders" may be used to indicate observed or inferred presence.

GUIDE TO SUBSURFACE EXPLORATION LOGS



INDEX SHEET 3 ROCK DESCRIPTION

ROCK DEFINITION

Where reported on an exploration log, *rock* is defined as any naturally formed aggregate of mineral matter occurring in larges masses or fragments. This definition of rock should not be taken as a replacement for any definitions relating to rock and/or rock excavation defined in construction documents. Intensely weathered or decomposed rock that is friable and can be reduced to gravel size particles or smaller by normal hand pressure is identified and described as soil. Poorly indurated formational materials which display both rock-like and soil-like properties are identified and described as rock followed by the soil description. In such cases, the term "poorly indurated" or "weakly cemented" is added to the rock name (e.g. weakly cemented sandstone).

ROCK IDENTIFICATION

Rock is identified by a combination of *rock type* (igneous, metamorphic, or sedimentary) followed by the the *rock name* (e.g. granite, schist, sandstone).

ROCK DESCRIPTION

Rock descriptions are presented in the following general sequence. The detail of description is dictated by the complexity and objectives of the project.

Identification Components

(1) Rock Type and Name

Description Components

- (2) Rock Grain Size (*for clastic sedimentary rock*)
- (3) Crystal Size (*for igneous and metamorphic rock*)
- (4) Bedding Spacing (*for sedimentary rock*)
- (5) Color
- (6) Hardness and Weathering Descriptors
- (7) Fracture Density
- (8) [Geologic Formation Name]

ROCK QUALITY DESIGNATION

$$RQD (\%) = \frac{\sum \text{Length of intact core pieces} \geq 4 \text{ inches}}{\text{Total length of core run (inches)}} \times 100$$

The RQD should correlate with the fracture density in most cases. Higher RDQ values generally indicate fewer joints and fractures.

GRAIN / CRYSTAL SIZE

Grain Size for Clastic Sedimentary Rock

The names of clastic sedimentary rocks are generally based on their predominant clast or grain size (e.g. fine sandstone, medium sandstone, coarse gravel conglomerate, cobble conglomerate, siltstone, claystone).

Crystal Size for Igneous and Metamorphic Rock

Grain Size Description	Average Crystal Size (in.)
Very coarse grained (pegmatitic)	Greater than or equal to 3/8
Coarse-grained	Between 3/16 and 3/8
Medium-grained	Between 1/32 and 3/16
Fine-grained	Between 1/250 and 1/32
Aphanitic	Less than or equal to 1/250

BEDDING SPACING

Bedding Description	Thickness / Spacing
Massive	Less than 10 ft.
Very thickly bedded	3 ft. to 10 ft.
Thickly bedded	1 ft. to 3 ft.
Moderately bedded	4 in. to 1 ft.
Thinly bedded	1 in. to 4 in.
Very thinly bedded	1/4 in. to 1 in.
Laminated	Less than 1/4 in.

Note: Bedding is generally only applicable to sedimentary or bedded volcanic rocks.

HARDNESS

Hardness	Criteria
Extremely hard	Cannot be scratched with a pocketknife or sharp pick. Can only be chipped with repeated heavy hammer blows.
Very hard	Cannot be scratched with a pocketknife or sharp pick with difficulty. Breaks with repeated heavy hammer blows.
Hard	Can be scratched with with a pocketknife or sharp pick with difficulty. Breaks with heavy hammer blows.
Moderately hard	Can be scratched with a pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows.
Moderately soft	Can be grooved 1/16 in. deep with a pocketknife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily with a pocketknife or sharp pick. Breaks with light to moderate manual pressure.
Very soft	Can be readily indented, grooved, or gouged with fingernail, or carved with a pocketknife. Breaks with light manual pressure.

WEATHERING (INTACT ROCK)

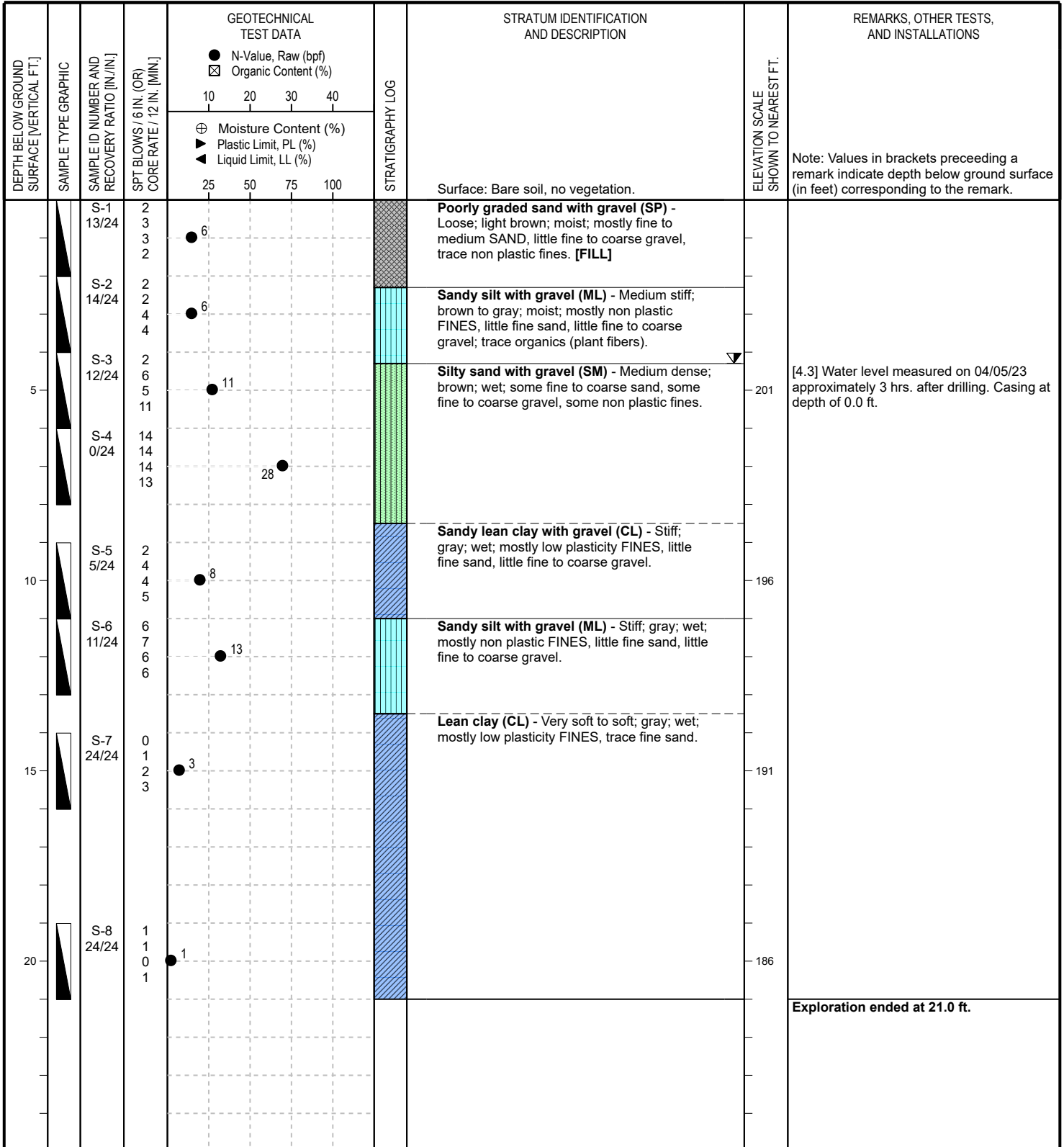
Weathering Description	Discoloration and/or Oxidation	General Characteristics
Fresh	Body of rock and fracture surfaces are not discolored or oxidized.	Rock texture unchanged. Hammer rings when crystalline rocks are struck.
Slightly weathered	Discoloration or oxidation limited to surface of, or short distance from, fractures. Most surfaces exhibit minor to complete discoloration.	Rock texture preserved. Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately weathered	Discoloration or oxidation extends usually throughout. Fe-Mg minerals appear rusty. All fracture surfaces are discolored or oxidized.	Rock texture generally preserved. Hammer does not ring when rock is struck. Body of rock slightly weakened.
Intensely weathered	Discoloration or oxidation throughout. Feldspar and Fe-Mg minerals altered to clay to some extent. All fracture surfaces are discolored or oxidized and friable.	Rock texture altered by chemical disintegration. Can usually be broken with moderate to heavy manual pressure or by light hammer blow . Body of rock is significantly weakened.
Decomposed	Discoloration or oxidation throughout but resistant minerals such as quartz may be unaltered. All feldspar and Fe-Mg minerals are completely altered to clay.	Resembles a soil; partial or complete remnant rock structure may be preserved. Can be granulated by hand. Resistant minerals may present as stringers or dikes.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures
Very slightly fractured	Core lengths greater than 3 ft.
Slightly fractured	Core lengths mostly from 1 ft. to 3 ft.
Moderately fractured	Core lengths mostly from 4 in. to 1 ft.
Intensely fractured	Core lengths mostly from 1 in. to 4 in.
Very intensely fractured	Mostly chips and fragments

Note: Fracture density is based on the fracture spacing in recovered core, measured along the core axis (excluding mechanical breaks).

CONTRACTOR: NE Boring Contractors, Inc.	BORING LOCATION: See Attached Figure	DATE START: April 5, 2023
FOREMAN: B. Thompson	ADVANCE METHOD: Rotary Wash Drilling	DATE FINISH: April 5, 2023
LOGGED BY: S. Wuebbolt, EIT	AUGER DIAMETER: N/A	GROUND EL: 206.0 ± (NAVD88)
CHECKED BY: T. Strike, PE	SUPPORT CASING: Driven Flush-Joint Casing (4" ID)	FINAL DEPTH: 21.0 ft.
EQUIPMENT: All-Terrain Drill Rig	CORING METHOD: N/A	GRID COORDS: N/A
SPT HAMMER: Automatic (140-lb.)	BACKFILL MATERIAL: Drill Cuttings	GRID SYSTEM: N/A

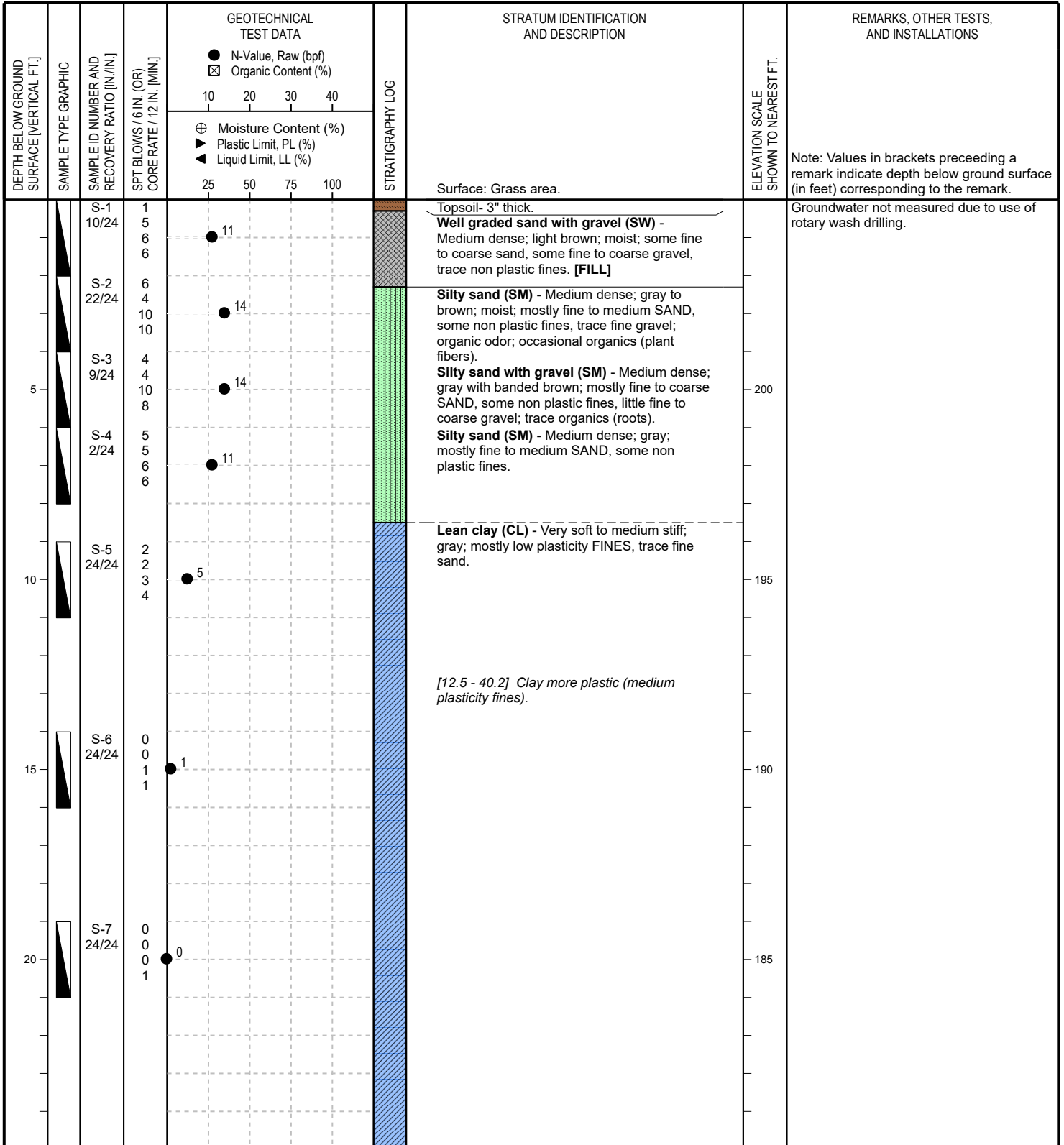


Note: Values in brackets preceding a remark indicate depth below ground surface (in feet) corresponding to the remark.

[4.3] Water level measured on 04/05/23 approximately 3 hrs. after drilling. Casing at depth of 0.0 ft.

Exploration ended at 21.0 ft.

CONTRACTOR: NE Boring Contractors, Inc.	BORING LOCATION: See Attached Figure	DATE START: April 5, 2023
FOREMAN: B. Thompson	ADVANCE METHOD: Rotary Wash Drilling	DATE FINISH: April 5, 2023
LOGGED BY: S. Wuebbolt, EIT	AUGER DIAMETER: N/A	GROUND EL: 205.0 ± (NAVD88)
CHECKED BY: T. Strike, PE	SUPPORT CASING: Driven Flush-Joint Casing (4" ID)	FINAL DEPTH: 40.5 ft. (Refusal)
EQUIPMENT: All-Terrain Drill Rig	CORING METHOD: N/A	GRID COORDS: N/A
SPT HAMMER: Automatic (140-lb.)	BACKFILL MATERIAL: Drill Cuttings	GRID SYSTEM: N/A



Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	SAMPLE ID NUMBER AND RECOVERY RATIO [IN./IN.]	SPT BLOWS / 6 IN. (OR) CORE RATE / 12 IN. [MIN.]	GEOTECHNICAL TEST DATA				STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
				● N-Value, Raw (bpf)	☒ Organic Content (%)	⊕ Moisture Content (%)	▶ Plastic Limit, PL (%)				
				10	20	30	40				
				25	50	75	100				
30										175	
35										170	
40		S-8 0/0	50/0							165	[40.2 - 40.5] Roller bit grinding into possible boulder or bedrock. Roller bit and sampler refusal at 40.5 ft. Exploration ended.
45										160	
50										155	

Attachment C

“Important Information about this Geotechnical Engineering Report” by GBA, Inc.

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals’ plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note*

conspicuously that you’ve included the material for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* **Confront the risk of moisture infiltration** by including building-envelope or mold specialists on the design team. **Geotechnical engineers are not building-envelope or mold specialists.**



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SECTION 00 31 43

PERMITS

PART 1 – GENERAL

1.01 DESCRIPTION:

This Section provides specific information and defines specific requirements of the Contractor regarding the preparation and acquisition of permits required to perform the work of this project.

1.02 RELATED WORK:

- A. Section 01 11 00, CONTROL OF WORK AND MATERIALS
- B. Section 01 14 19.16, DUST CONTROL
- C. Section 01 57 19, ENVIRONMENTAL PROTECTION
- D. Section 31 00 00, EARTHWORK
- E. Section 31 23 19, DEWATERING

1.03 GENERAL REQUIREMENTS:

- A. The Owner has obtained or will obtain and pay for the permits listed below, which are required for this project. The Contractor shall assist in obtaining certain permits, as indicated. The Contractor shall obtain and pay for all other permits required, as defined under the Permits subsection of Section C-1.1, GENERAL CONDITIONS.

<u>Permits by Owner</u>	<u>Status</u>
Building Permit	*
Emergency Generator Permit	**
Demolition Permit	***

*Contractor shall prepare permit application and obtain the permit after contract is awarded, bearing all expenses. Owner will pay for and/or waive the permit application fee, if applicable.

** The total heat input of the engine, as proposed, is less than the permitting threshold and therefore does not require a permit. If the engine purchased is larger than that proposed and the

heat input exceeds the permitting threshold, then a permit application must be submitted prior to the installation of the new or modified device. Rule Note: for multiple engines, the heat input for all engines that are greater than or equal to 10% of the permit threshold (0.15 MMBtu/hr.) must be totaled to establish the total heat input for the installation. If the total heat input for the installation exceeds 1.5 MMBtu/hr., then a permit is required.

***This facility as described in Env-A 1802.27 requires a demolition permit. A Notification for Demolition of a facility must be submitted to NHDES at least 10 working days prior to the start of demolition. In addition, the Contractor shall secure and pay for an inspection for asbestos and must be conducted of the facility and any asbestos-containing materials (ACM), if identified, must be removed prior to demolition. If ACM is found and includes the removal of ACM, there may be additional notification requirements and required procedures for the removal, packaging, and disposal of any ACM, that are required by Env-A 1800. NHDES' Asbestos Management Section should be contacted if any of the above is planned to occur. Fees for inspection to be paid for by Contractor. Fees for Demolition Permit to be paid for or waived by Owner.

PART 2 - PRODUCTS

Not Used.

PART 3 – EXECUTION

3.01 PERFORM WORK IN ACCORDANCE WITH REQUIREMENTS:

- A. The Contractor shall perform the work in accordance with the Contract Documents, including any applicable municipal requirements.

END OF SECTION

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SECTION 01 11 00

CONTROL OF WORK AND MATERIALS

PART 1 – GENERAL

Not Used.

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 HAULING, HANDLING AND STORAGE OF MATERIALS:

- A. The Contractor shall, at its own expense, handle and haul all materials furnished by it and shall remove any of its surplus materials at the completion of the work.
- B. The Contractor shall provide suitable and adequate storage for equipment and materials furnished by it that are liable to injury and shall be responsible for any loss of or damage to any equipment or materials by theft, breakage, or otherwise.
- C. All excavated materials and equipment to be incorporated in the Work shall be placed so as not to injure any part of the Work or existing facilities and so that free access can be had at all times to all parts of the Work and to all public utility installations in the vicinity of the work. Materials and equipment shall be kept neatly piled and compactly stored in such location as will cause a minimum of inconvenience to public travel and adjoining owners, tenants and occupants.
- D. The Contractor shall be responsible for all damages to the work under construction during its progress and until final completion and acceptance even though partial payments have been made under the Contract.

3.02 EASEMENTS:

- A. As indicated on the drawings, the work is located in easements obtained by the Owner. The Contractor has no rights outside of the easements unless they are obtained from the property owner.
- B. Contractor shall schedule work so that it will cause minimum inconvenience and nuisance to abutting property owners, over the shortest possible time.
- C. Easements shall be kept clean; no rubbish or discarded construction materials shall be allowed to accumulate. Storage of excess construction materials, including soil, ledge, equipment, or machinery on easements will not be allowed.

- D. Restoration of fences, shrubs, trees and grass shall be completed promptly following completion of the work in an easement, to minimize disruption and inconvenience to property owners.
- E. Unless approved by the Engineer, the use of easements for ease of access to and egress from other areas of the project will not be permitted.

3.03 OPEN EXCAVATIONS:

- A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at its own expense, provide suitable and safe means for completely covering all open excavations and for accommodating travel when work is not in progress.
- B. Bridges provided for access to private property during construction shall be removed when no longer required.
- C. The length of open trench will be controlled by the particular surrounding conditions but shall always be confined to the limits prescribed by the Engineer.
- D. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, then special construction procedures shall be taken, such as limiting the length of trench and prohibiting stocking excavated material in the street.
- E. All street excavations shall be completely closed at the end of each work day. Backfilling or use of steel plates of adequate strength to carry traffic shall be used.

3.04 CARE AND PROTECTION OF PROPERTY:

The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be promptly restored by the Contractor, at its expense, to a condition similar or equal to that existing before the damage was done, to the satisfaction of the Engineer.

3.05 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES:

- A. All existing buildings, utilities, pipes, poles, wires fences, curbing, property line markers and other structures which the Engineer decides must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damage by the contractor. Should such property be damaged, it shall be restored by the Contractor, at no additional cost to the Owner.

- B. The Contractor shall determine the location of all underground structures and utilities (including existing water services, drain lines, electrical lines, and sewers). Services to buildings shall be maintained, and all costs or charges resulting from damage thereto shall be paid by Contractor.
- C. On paved surfaces the Contractor shall not use or operate tractors, bulldozers, or other power-operated equipment with treads or wheels which are shaped so as to cut or otherwise damage such surfaces.
- D. All property damaged by the Contractor's operations shall be restored to a condition at least equal to that in which it was found immediately before work was begun. Suitable materials and methods shall be used for such restoration.
- E. Restoration of existing property and structures shall be carried out as promptly as practicable and shall not be left until the end of the construction period.

3.06 MAINTENANCE OF FLOW:

- A. The Contractor shall at its own cost, provide for the flow of sewers and drains interrupted during the progress of the work, and shall immediately cart away and dispose of all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the Engineer well in advance of the interruption of any flow.
- B. All existing drainage facilities including, but not limited to; brooks, streams, canals, channels, ditches, culverts, catch basins and drainage piping shall be adequately safeguarded so as not to impede drainage or to cause siltation of downstream areas in any manner whatsoever. If the Contractor damages or impairs any of the aforesaid drainage facilities, it shall repair the same within the same day.
- C. At the conclusion of the work, the Contractor shall remove all silt in drainage structures caused by its operations as described in Section 01 74 13, CLEANING UP.

3.07 REJECTED MATERIALS AND DEFECTIVE WORK:

- A. Materials furnished by the Contractor and condemned by the Engineer as unsuitable or not in conformity with the specifications shall forthwith be removed from the work by the Contractor, and shall not be made use of elsewhere in the work.
- B. Any errors, defects or omissions in the execution of the work or in the materials furnished by the Contractor, even though they may have been passed or overlooked or have appeared after the completion of the work, discovered at any time before the final payment is made hereunder, shall be forthwith rectified and made good by and at the expense of the Contractor and in a manner satisfactory to the Engineer.
- C. The Contractor shall reimburse the Owner for any expense, losses or damages incurred in consequence of any defect, error, omission or act of the Contractor or his employees,

as determined by the Engineer, occurring previous to the final payment.

3.08 SANITARY REGULATIONS:

Sanitary conveniences for the use of all persons employed on the work, properly screened from public observation, shall be provided in sufficient numbers in such manner and at such locations as may be approved. The contents shall be removed and disposed of in a satisfactory manner as the occasion requires. The Contractor shall rigorously prohibit the committing of nuisances within, on or about the work. Any employees found violating these provisions shall be discharged and not again employed on the work without the written consent of the Engineer. The sanitary conveniences specified above shall be the obligation and responsibility of the Contractor.

3.09 SITE INVESTIGATION:

The Contractor acknowledges that it has satisfied itself as to the conditions existing at the site of the work, the type of equipment required to perform this work, the quality and quantity of the materials furnished insofar as this information is reasonably ascertainable from an inspection of the site, as well as from information presented by the drawings and specifications made a part of this contract. Any failure of the Contractor to acquaint itself with available information will not relieve it from the responsibility for estimating properly the difficulty or cost of successfully performing the work. The Owner assumes no responsibility for any conclusion or interpretation made by the Contractor on the basis of the information made available by the Owner.

3.10 HANGERS, PADS, AND SUPPORTS:

- A. Unless otherwise indicated, hangers and supports shall be by the trade providing the supported item.
- B. Except where detailed or specified, design of hangers and supports shall be the responsibility of the Contractor. All parts of such hangers or supports shall be designed in accordance with accepted engineering practice, using a factor of safety of at least 2½.
- C. When proprietary hangers, etc., are supplied, satisfactory evidence of the strength of such items shall be furnished.
- D. Hangers for items hung from steel and concrete shall be centered on the vertical center of gravity of the beam.
- E. Locations and sizes of openings, sleeves, concrete pads, steel frames, and other equipment supports are indicated on the drawings for bidding purposes only. Final sizes and locations of such items shall be obtained from the shop drawings.

3.11 SLEEVES, HOLES, HANGERS, INSERTS, ETC.:

- A. Except where holes and openings are dimensioned, and hangers, inserts, and supports are fully called for on the architectural and structural drawings (or reference is made thereon to drawings containing such information) to accommodate mechanical or electrical items, they shall be by the mechanical or electrical trade concerned.
- B. Sleeves, inserts, anchors, etc., supplied under the mechanical and electrical contracts in sufficient time to so permit, shall be set in concrete, masonry, etc., or fastened to steel deck, etc., by the respective architectural or structural trade. Where not supplied in sufficient time, installation of such items shall be the responsibility of the mechanical or electrical trade involved.
- C. Nothing shall be suspended from the steel roof deck and no fastenings made to it, except with the prior permission of the Engineer. Request for permission shall be accompanied by full details of the hanger or fastener, including the weight of the item to be suspended.
- D. Nailers and other wood members attached to steel or masonry, for which fasteners are not indicated on the design drawings or in the specification, shall be fastened with the equivalent of ½-inch diameter bolts at 3 feet o.c.
- E. Openings for mechanical and electrical items in finished areas of the building shall be closed off with near escutcheon plates or similar closures. These closures shall be by the mechanical or electrical trade involved.

3.12 ROOF PROTECTION:

Where work must be performed over completed roofing, the roofing shall be protected by 2 layers of ½-inch thick plywood, laid with joints in the second layer offset 1/2 sheet width and length from joints in the first layer. No material shall be stored or work performed on areas of roof which are not so protected.

3.13 WEATHER PROTECTION:

The General Contractor shall install weather protection and shall furnish adequate heat in the area so protected during the months of November through March. Standards for such specifications shall be established by the Director of Building Construction in the Executive Office for Administration and Finance.

3.14 ELECTRIC SERVICE:

- A. The Contractor shall make all necessary applications and arrangements and pay for all fees and charges for electrical energy for power and light necessary for the proper completion of this contract during its entire progress. The Contractor shall provide and pay for all temporary wiring, switches, connections, and meters.
- B. There shall be sufficient electric lighting so that all work may be done in a

workmanlike manner where there is not sufficient daylight.

END OF SECTION

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SECTION 01 12 16

SCOPE AND SEQUENCE OF WORK

PART 1 – GENERAL

1.01 WORK INCLUDED:

- A. Removal of existing suction lift pump station fiberglass housing; pumps; suction piping; standby generator; and other electrical components.
- B. Bypass pumping, site work and grading, geotechnical ground improvement, concrete foundation, paving and landscaping.
- C. Installation of new suction piping; package duplex suction-lift pump skid; standby generator; pump station building; electrical and controls.
- D. Repair and coating of concrete wetwell.

1.02 RELATED WORK:

- A. SECTION 01 11 00 – CONTROL OF WORK AND MATERIALS

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 GENERAL:

- A. The Contractor shall be responsible for scheduling its activities and the activities of any subcontractors involved, to meet the completion date, or milestones, established for the contract. Scheduling of the work shall be coordinated with the Owner and Engineer.
- B. The Construction Sequence Requirements shall be used by the Contractor to form a complete schedule for the project, which shall be coordinated with the Owner and Engineer. Prior to performing any work at the site, the Contractor shall submit a detailed plan to the Engineer for review. The plan shall describe the proposed sequence, methods, and timing of the work.

3.02 CONSTRUCTION SEQUENCING REQUIREMENTS:

- A. Contractor shall work with the Engineer and Owner to determine construction

sequencing needs.

- B. Contractor shall follow the directives and requirements as required in all permits pertaining to this Project.

END OF SECTION

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12 16 Scope and Sequence of Work.docx

SECTION 01 14 00

SPECIAL PROVISIONS

PART 1 - GENERAL

Not used

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

3.01 WATER FOR CONSTRUCTION PURPOSES:

- A. In locations where water is in sufficient supply, the Contractor may be allowed to use water without charge for jetting backfill and other construction purposes. The express approval of the Owner shall be obtained before water is used. Waste of water by the Contractor shall be sufficient cause for withdrawing the privilege of unrestricted use.
- B. If no water is available, the Contractor shall supply water at no additional cost to the Owner.

3.02 PIPE LOCATION:

Pipe shall be located substantially as indicated on drawings. The Owner reserves the right, acting through the Engineer, to make such modifications as may be deemed desirable to avoid interference with existing structures or for other reasons.

3.03 DIMENSIONS OF EXISTING STRUCTURES:

Where the dimensions and locations of existing structures are of critical importance in the installation or connections of new work, the Contractor shall verify such dimensions and locations in the field before the fabrication of any material or equipment that is dependent on the correctness of such information.

3.04 OCCUPYING PRIVATE PROPERTY:

The Contractor shall not enter upon nor occupy with men, equipment or materials any property outside of the public highways or Owner's easements, except with the written consent of the property owner or property owner's agent.

3.05 EXISTING UTILITY LOCATIONS – CONTRACTOR'S RESPONSIBILITY:

- A. The location of existing underground services and utilities shown on the drawings is based on available records. It is not warranted that all existing utilities and services are

shown, or that shown locations are correct. The Contractor shall be responsible for having the utility companies locate their respective utilities on the ground prior to excavating.

- B. To satisfy the requirements of New Hampshire Statute RSA-374, Section 47-56, the Contractor shall, at least 72 hours, exclusive of Saturdays, Sundays and holidays, prior to excavation in the proximity of telephone, gas, cable television and electric utilities, notify the utilities concerned by calling "DIG SAFE" at telephone number: 1-888-344-7233.
- C. The Contractor shall coordinate all work involving utilities and shall satisfy itself as to the existing conditions of the areas in which it is to perform his work. It shall conduct and arrange its work so as not to impede or interfere with the work of other contractors working in the same or adjacent areas.

3.06 COORDINATION OF WORK:

The General Contractor shall be responsible for coordinating its own work as well as that of any subcontractors. It shall be responsible for notification of the Engineer when each phase of work is expected to begin and the approximate completion date.

3.07 TIME FOR COMPLETION OF CONTRACT:

The time for completion of this contract is stipulated in the Form of/for General Bid. The Bidder shall base his bid on completing the proposed work by the completion date stipulated in Section A – 3.1, BID.

3.08 MAINTENANCE OF TRENCH SURFACE:

After backfilling and compacting the trench, the Contractor shall be responsible for keeping the ground surface dry and passable at all times until the surface has been restored to original conditions.

3.09 DESIGN OF EQUIPMENT:

Attention is directed to the fact that the layout of certain equipment is based on that of one manufacturer. If other equipment is submitted for approval, the Contractor shall prepare and submit for approval at its expense, detailed structural, mechanical and electrical drawings, equipment lists, maintenance requirements, and any other data required by the Engineer, showing all necessary changes and embodying all special features of the equipment he proposes to furnish. Such changes, if approved, shall be made at the expense of the Contractor.

3.10 SERVICES OF MANUFACTURER'S REPRESENTATIVE:

- A. The Contractor shall arrange for a qualified service representative, at a time suitable to the Engineer, from the company manufacturing or supplying certain equipment as

indicated on the detailed specifications, to perform the duties described herein.

- B. After installation of the listed equipment has been completed and the equipment is presumably ready for operation, but before others operate it the representative shall inspect, operate, test, and adjust the equipment. The inspection shall include, but shall not be limited to, the following points as applicable:
1. Soundness (without cracks or otherwise damaged parts); completeness in all details, as specified; correctness in setting, alignment, and relative arrangement of various parts; adequacy and correctness of packing, sealing and lubricants.
 2. The operation, testing, and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified. Where called for in the specifications, vibration readings shall be made and the equipment balanced accordingly.
 3. On completion of its work, the Contractor shall submit in triplicate to the Engineer the manufacturer's or supplier representative's complete signed report of the results of its inspection, operation, adjustments, and test. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. The report shall also include a certificate that the equipment conforms to the requirements of the contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
 4. After the Engineer has reviewed the reports from the manufacturer's representative, the Contractor shall make arrangements to have the manufacturer's representative present when the field acceptance tests are made.

3.11 PROJECT SIGN:

- A. The sign shall be erected within ten (10) days after the construction contract is awarded. The sign shall be fabricated, erected, and maintained by the Contractor.
- B. The Contractor shall provide adequate support for the sign as determined by the Engineer. All supports, trim, and back of sign shall be painted with at least two coats of exterior paint.
- C. The project sign shall be maintained by the Contractor in good condition at all times for the duration of construction. The Contractor shall remove the sign upon completion of construction.

3.12 COMPLIANCE WITH PERMITS:

- A. The Contractor shall perform all work in conformance with requirements of the Permits, which appear in Section 00 31 43 – PERMITS.

3.13 CUTTING, FITTING AND PATCHING:

- A. The Contractor shall do all cutting, fitting, or patching of its work that may be required to make its several parts come together properly and fit it to receive or be received by work of other Contractors, as shown upon or reasonably implied by the drawings and the specifications for the completed structure, including all existing work.
- B. The Contractor shall not endanger any work by cutting, digging, or otherwise and shall not cut or alter the work of any other Contractor, save with the consent of the Engineer.
- C. All holes or openings required to be made in new or existing work, particularly at pipe, conduit, or other penetrations not covered by escutcheons or plates shall be neatly patched. All such holes shall be made completely watertight as approved by the Engineer.
- D. Size and locations of holes required in steel, concrete, or other structural or finish materials for piping, wiring, ducts, etc., which have not been located and detailed on the drawings shall be approved by the Engineer prior to layout and cutting thereof. All holes shall be suitably reinforced as required by the Engineer.
- E. Workmanship and materials of patching and repair work shall match the adjacent similar work and shall conform to the applicable sections of the specification. Patches and joints with existing work shall provide, as applicable in each case, visual, structural, and waterproofing continuity.

3.14 CONNECTIONS TO EXISTING WATER SYSTEMS:

- A. The Owner will, upon 72-hour notice from the Contractor, assist the Contractor by locating and opening or closing any and all valves required for draining or admitting water to the various sections of the water main as required to perform the proposed work. No damages shall be claimed by the Contractor for delays in dewatering pipelines nor shall any damages be claimed because of water leaking through closed valves after dewatering is completed.
- B. Connections to the existing distribution system shall be made with the mains under pressure unless the lines can be temporarily taken out of service as approved by the Owner.
- C. The Contractor will be required to make test excavations to ascertain that the proposed position of the connections will be clear of joints, fittings, or other obstructions.
- D. If any failure occurs in connection to existing mains, service shall be restored in the

shortest possible time, the Contractor working around the clock, if necessary. The Contractor shall cooperate with the Owner in notifying the consumers or supplying emergency water. If required by Owner, the Contractor shall make connections to water mains during night hours, on Sunday or at other times of off-peak demand for water.

3.15 CONTRACTOR'S REPRESENTATIVE:

The Contractor shall designate a representative who will be available to respond to emergency calls by the Owner at any time day and night and on weekends and holidays should such a situation arise.

3.16 VISUAL RECORDING:

Before beginning construction, the Contractor shall make a color DVD recording along the entire work length. One complete recording, for the entire project length, shall be furnished to the Engineer prior to the start of the work. The visual recording shall be identified by street name, as applicable, and station.

3.17 OPERATOR TRAINING:

A trained representative of the manufacturer of all equipment shall instruct the plant operating personnel on the operation and maintenance of the equipment. The Owner reserves the right to videotape all training sessions.

3.18 HOURS OF CONSTRUCTION ACTIVITY:

- A. The Contractor shall conduct all construction activity between 7:00 a.m. and 5:00 p.m., Monday through Friday. No construction work shall be allowed on Saturdays, Sundays or Holidays without written authorization from the Owner.
- B. The Owner will provide personnel for assistance in locating and operating valves at no cost to the Contractor during the Owner's normal working hours (Monday through Friday 7:00 a.m. to 5:00 p.m.). When this assistance is required by the Contractor outside of the Owner's normal working hours the cost will be incurred by the Contractor at the prevailing overtime rate of pay for the personnel providing the assistance. The Owner will bill the Contractor directly.

3.19 CONSTRUCTION CREWS:

The Contractor shall not increase the number of construction crews assigned to the work without providing one-week advance notice to the Engineer.

END OF SECTION

SECTION 01 14 19.13

TEMPORARY BYPASS PUMPING SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section includes furnishing of all materials, labor, equipment, power, and maintenance, to implement a temporary pumping system for the purpose of diverting existing sanitary sewer flows around the work area for the duration of the project.
- B. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor firm who can demonstrate to the Engineer that it has the required expertise in the design and operation of temporary bypass pumping systems. The vendor firm shall provide at least five references of projects similar in size and complexity to this project that have been performed by the firm within the past three years.
- C. The by-pass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

1.02 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. The Contractor shall submit a detailed description of the proposed pumping system stamped by a Professional Engineer in the State of New Hampshire and submit it and the vendor's references.
- B. The Contractor shall submit to the Engineer detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing sanitary sewer flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these contract documents. No construction shall begin until all provisions and requirements have been reviewed by the Engineer.
- C. The plan shall include but not be limited to the following:
 - 1. Staging areas for pumps;
 - 2. Flow diversion method and types of materials;
 - 3. Number, size, material, location and method of installation of suction piping;

4. Number, size, material, method of installation and location of discharge piping;
5. Bypass pump sizes, capacity, number of each size to be on site and the related power requirements;
6. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);
7. Standby power generator size, location;
8. Downstream discharge plan;
9. Method of protecting suction and discharge areas from erosion and damage;
10. Thrust and restraint block sizes and locations;
11. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill;
12. Method of noise control for each pump and/or generator, with external dB valve.
13. Any temporary pipe supports and anchoring required;
14. Design plans and computation for access to bypass pumping locations indicated on the drawings;
15. Calculations for selection of bypass pumping pipe size;
16. Schedule for installation of and maintenance of bypass pumping lines;
17. Plan indicating proposed location of bypass pumping lines.

D. All bypass pumping submittals described in Section 1.02-A through 1.02-C must be submitted to the Engineer within two weeks of notice to proceed.

1.03 RELATED WORK:

A. Section 01 12 16, SCOPE AND SEQUENCE OF WORK

PART 2 - MATERIALS

2.01 EQUIPMENT:

A. All pumps used shall be centrifugal, end suction, fully automatic self-priming units that do not require the use of foot-valves, diaphragm pumps, isolation valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. All

pumps used must be constructed to allow dry running for long periods to accommodate the cyclical nature of bypass flows. The pumps shall not be hydraulic submersible type.

- B. All pumps shall be Godwin Dri-prime Automatic Self-priming Pumps (CD, DPC, or HL Series) as manufactured by Xylem, (860) 889-2343, (207) 233-8322, or approved equal.
- C. The Contractor shall provide the necessary stop/start controls for each pump.
- D. The Contractor shall include one stand-by pump system (including suction and discharge piping) of each size to be maintained on site.
- E. Additional back-up pumps shall be on-line, isolated from the primary system by a valve.
- F. Discharge Piping - in order to prevent the accidental spillage of flows, all temporary discharge systems shall be constructed of rigid pipe with positive, restrained joints. Under no circumstances will aluminum "Irrigation" type piping or glued PVC pipe be allowed. Discharge hoses will only be allowed in short sections and with the specific permission of the Engineer.
- G. Allowable piping materials will be Godwin "QD" steel pipe (Xylem), or fused, high-density polyethylene pipe as manufactured by Xylem, or approved equal.

2.02 SYSTEM DESCRIPTION:

A. DESIGN REQUIREMENTS:

1. Bypass pumping systems shall have sufficient capacity to pump a peak flow of 195 gpm at 25-feet of total dynamic head. The Contractor shall provide all pipeline, plugs, pumps of adequate size to handle peak flow, and discharge piping to ensure that the total flow can be safely diverted around the area of work. Bypass pumping system will be required to operate 24 hours per day.
2. The Contractor shall have adequate standby power and pumping equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.
3. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performance of work.

B. PERFORMANCE REQUIREMENTS:

1. It is essential for the protection of the public safety and private property that there be no interruption in the flow throughout the duration of the project. To this end,

the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sanitary sewer flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing force main on site.

2. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
3. The Contractor shall provide all necessary means to safely convey the sanitary sewer flow past the work area. The Contractor will not be permitted to stop or impede the flows under any circumstances.
4. The Contractor shall maintain flow around the work area in a manner that will not cause surcharging or significant level variations in the existing gravity sewer system, and that will protect public and private property from damage and flooding.
5. The Contractor shall protect water resources, wetlands and other natural resources.
6. The Contractor shall be responsible to meet noise requirements (73dbA @ 30'). All diesel driven primary and standby pumps shall be sound attenuated. The use of Critical Silenced Canopy Pumps or acoustical Whisper Pac enclosures for sound attenuation is required.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL AND MAINTENANCE.

- A. The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The Engineer shall be given 24 hours notice prior to testing.
- B. Contractor shall inspect bypass pumping system every two hours to ensure that the system is working correctly.
- C. The Contractor shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.
- D. Spare parts for pumps and piping shall be kept on site as required.
- E. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.02 PRECAUTIONS:

- A. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the Owner and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.
- B. During all bypass pumping operation, the Contractor shall protect the work area and all local utilities from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to public and private property caused by human or mechanical failure.

3.03 INSTALLATION AND REMOVAL:

- A. The Contractor shall construct temporary bypass pumping structures only at the access locations indicated on the drawings and may be required to provide adequate suction conduit.
- B. Diverting or blocking of sanitary sewer flows shall incorporate primary and secondary devices. When diversion or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.
- C. The Contractor shall exercise caution and comply with OSHA requirements when working in the presence of gases, combustible or oxygen-deficient atmospheres, and confined spaces.
- D. Except as specifically permitted, the installation of the bypass pipelines is prohibited in all salt marsh/wetland areas. The pipeline must be located off streets and sidewalks and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the Contractor must place the bypass pipelines in trenches and cover with temporary pavement. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Engineer, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement. The Contractor is responsible for obtaining any approvals from the Owner for placement of the temporary pipeline within public ways.

END OF SECTION

SECTION 01 14 19.16

DUST CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION:

This section of the specification covers the control of dust via calcium chloride and water, complete.

PART 2 - PRODUCTS

2.01 CALCIUM CHLORIDE:

- A. Calcium chloride shall conform to the requirements of AASHTO-M 144, Type I or Type II and Specification for Calcium Chloride, ASTM D98. The calcium chloride shall be packaged in moisture proof bags or in airtight drums with the manufacturer, name of product, net weight, and percentage of calcium chloride guaranteed by the manufacturer legibly marked on each container.
- B. Calcium chloride failing to meet the requirements of the aforementioned specifications or that which has become caked or sticky in shipment, may be rejected by the Engineer.

2.02 WATER:

- A. Water shall not be brackish and shall be free from oil, acid, and injurious alkali or vegetable matter.

PART 3 - EXECUTION

3.01 APPLICATION:

- A. Calcium chloride shall be applied when ordered by the Engineer and only in areas which will not be adversely affected by the application. See Section 01 57 19, ENVIRONMENTAL PROTECTION.
- B. Calcium chloride shall be uniformly applied at the rate of 1-1/2 pounds per square yard or at any other rate as required by the Engineer. Application shall be by means of a mechanical spreader, or other approved methods. The number and frequency of applications shall be determined by the Engineer.
- C. Water may be sprinkler applied with equipment including a tank with gauge-equipped pressure pump and a nozzle-equipped spray bar.

- D. Water shall be dispersed through the nozzle under a minimum pressure of 20 pounds per square inch, gauge pressure.

END OF SECTION

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SECTION 01 14 19.22

HANDLING EXISTING FLOWS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers all materials, equipment, and labor required to handle existing sanitary and combined sewage flows and installation and maintenance of all temporary connections, plugs, and by-pass pumping. Upon completion of the pump station, all temporary plugs and connections shall be removed and flows returned to the wetwells. Plug, fill, and abandon existing pipes and manholes as shown on the drawings or as specified herein.

1.02 RELATED WORK:

Section 01 33 23, SUBMITTALS

Section 01 14 19.13, TEMPORARY BYPASS PUMPING SYSTEM

Section 31 05 13.22, CONTROLLED DENSITY FILL

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Submit complete, checked shop drawings, showing equipment, method of by-passing, and the method of transferring flows from the existing system to the new system. Prior to starting work, the Contractor shall submit flow calculations for each pipeline to be bypassed that show pump capacity to be provided. Comply with requirements of Section 01 33 23.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 MAINTAINING EXISTING FLOWS:

- A. The Contractor shall maintain all flows in the existing system until construction of the pump station is complete and ready for safe operation.
- B. The Contractor shall protect against surcharging of the existing system upstream of the work area by installing adequate temporary by-pass pumping to handle dry weather and wet weather flows. The bypass system shall have a sufficient capacity to handle full pipe capacity for the pipeline section to be bypassed and shall provide and maintain sufficient flow at all times to prevent any backwater flooding due to obstructions caused by the construction.

- C. The Contractor shall repair any damage that occurs to existing pipes and structures to the satisfaction of the Engineer. Work performed under this section shall be considered incidental and shall not be measured separately for payment.
- D. Existing pipes to be abandoned shall be completely removed, as indicated on drawings.
- E. The Contractor shall not allow sanitary flow to discharge to any salt or fresh water body by means of overflow, by-pass pumping, or any other method that may contaminate these water areas.
- F. The temporary bypass pumping system shall include floats (or other acceptable level sensing devices) that will transmit a high water condition to an on-site autodialer that shall send an alarm condition to the Contractor's Superintendent. The autodialer shall also alert a designated "on-call" employee of the Contractor, should the Superintendent fail to acknowledge the call.

END OF SECTION

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SECTION 01 22 00

MEASUREMENT AND PAYMENT

1. General

- A. The following sections describe the measurement and payment for the work to be done under the respective items listed in the BID SCHEDULE.
- B. The lump sum price stated in the BID SCHEDULE shall constitute full compensation as herein specified, for all of the work completed in accordance with the drawings and specifications. All other activities required in connection with performance of the work, including all work required under Division 1, GENERAL REQUIREMENTS, whether described in the contract documents or mandated by applicable codes, permits and laws, will not be separately paid for unless specifically provided for in THE BID SCHEDULE, but will be considered to be incidental to performance of the overall project.

2. Item 1

The lump sum price for Item 1 shall constitute full compensation for furnishing all labor, materials, tools and equipment and constructing the project, complete, as shown on the drawings and called for in the specifications, except that work included for payment under Item 2.

3. Item 2

Payment of the cash allowance for Item 2 shall be full compensation for the equipment, appurtenances, and manufacturer's services associated with the pump station instrumentation and controls as specified in Section 40 91 00, Section 40 95 13, and the scope of supply attached to this section (Section 01 22 00a). All costs associated with the Contractor's installation and testing of the equipment as well as with coordination with the Manufacturer shall be included in Item 1.

END OF SECTION

April 24, 2024

(Quote Valid for 30 Days)



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LEE, NH 03861
617.701.3900: T
978.517.1321: F

Wilson Controls Quote #240229 Rev-1

Mr. John Sykora
Weston & Sampson
100 International Drive, Suite 152
Portsmouth, NH 03801
603-431-3937

Reference: Ledgeview Pump Station Upgrade – I&C Quote
Rochester, NH

Specifications: 90% Plans and Specifications

Dear John,

Wilson Controls is pleased to provide a scope of work and quotation for reference project and Specifications noted above for your review and consideration.

Pump Control Panel (PCP) (Qty. 1):

- 1) NEMA 12 Double Door Enclosure as Required
- 2) Enclosure LED Light
- 3) Enclosure Thermostat, Exhaust Vent & Fan.
- 4) PLC with I/O Modules
- 5) OIT as Specified
- 6) Ethernet Switch & VPN Router
- 7) Uninterruptible Power Supply
- 8) Control Power Transformer
- 9) Main Breaker with through the Door Disconnect
- 10) Pump Breakers with through the Door Disconnect
- 11) VFD's with Remote Mount Keypads on Door
- 12) Indicator Lights & Operator Switches as Required
- 13) Reset Pushbutton
- 14) Enclosure Receptacle
- 15) 24 VDC Redundant Power Supply
- 16) Elapsed Time Meter
- 17) Time Delay Relays as Required
- 18) Power and Analog Signal Surge Protection
- 19) Ancillary components to provide a functional control panel. i.e. circuit breakers, power supplies, terminal blocks, Fuses, Fuse Holders, Wire Duct, etc.
- 20) Control Panel will be fabricated to UL508A Standards and UL Listed

Intrinsically Safe Relay Panel (ISB) (Qty. 1):

- 1) NEMA 4X Stainless Steel Enclosure
- 2) Intrinsically Safe Relays as Required
- 3) Ancillary components to provide a functional control panel. i.e. circuit breakers, power supplies, terminal blocks, Fuses, Fuse Holders, Wire Duct, etc.
- 4) Control Panel will be fabricated to UL508A Standards and UL Listed



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Instrumentation:

- 1) Qty. 1 – 4” Magnetic Flow Meter
- 2) Qty. 1 – Submersible Level Sensor and Transmitter
- 3) Qty. 1 – Flood Float Switch

Spare Parts:

- 1) Qty. 1 - Submersible Level Sensor and Transmitter
- 2) Qty. 2 - Flood Float Switch
- 3) Qty. 1 – PLC CPU & Each Type I/O Module

Technical Services:

- 1) Submittals
- 2) Programming – PLC, OIT, SCADA & Reporting
- 3) Startup, Testing and Training
- 4) Final Documentation

Clarifications:

- 1) Field Installation and Wiring of Control Panel & Field Equipment by Others.
- 2) Supply and Installation of Miscellaneous mounting hardware, brackets & supports by others.
- 3) High Temp and Seal Failure Relays are by Others, Pump Supplier.

PRICING AND DELIVERY

Prices are based on quantities indicated and are priced each for items described above.

Proposal Price\$81,000.00

Submittals 5-8 weeks after receipt of Purchase Order
 Delivery: TBD Based on Supply Chain receipt of approved submittals

Thank you for the opportunity to quote you on this project. Please don't hesitate to call if you have questions or concerns: 603-422-5271

Sincerely,

Scott E. Drapeau

Scott E. Drapeau, P.E.
Wilson Controls, LLC

The information contained within this document is to be considered confidential and proprietary. It shall not be distributed or communicated to other individuals or parties except those directly involved with Wilson Controls, LLC and its affiliates on this particular application. Under no conditions shall this document or the information contained within be communicated to competitors of Wilson Controls, LLC and its affiliates.

SECTION 01 32 16

CONSTRUCTION SCHEDULING

PART 1- GENERAL

1.01 PROGRAM DESCRIPTION:

- A. A Critical Path Method (CPM) construction schedule shall be used to control the work of this Contract and to provide a definitive basis for determining job progress. The Contractor shall prepare the construction schedule. All work shall be done in accordance with the established CPM schedule and the Contractor and his subcontractors shall be responsible for cooperating fully with the Engineer and the Owner in effectively utilizing the CPM schedule.
- B. The CPM schedule to be prepared and submitted by the Contractor shall consist of a CPM network (diagram of activities) and a computer-generated schedule (print-out) as specified herein. The format shall be the activity-on-node precedence network.
- C. The Contractor shall develop his own outline of the work and prepare his proposed CPM schedule. The computer-based schedule shall be the product of a recognized commercial computer software producer and shall meet all of the requirements defined herein.

1.02 QUALIFICATIONS:

- A. The Contractor shall have the capability of preparing and utilizing the specified CPM scheduling technique. A statement of CPM capability shall be submitted by the Contractor in writing to the Engineer within 10 days after the issuance of the Notice to Proceed to verify that either the Contractor's organization has in-house capability qualified to use the technique or that the Contractor employs a consultant who is so qualified. Capability shall be verified by description of the construction projects to which the Contractor or his consultant has successfully applied the CPM scheduling technique and which were controlled throughout the duration of the project by means of systematic use and updating of a computer-based CPM schedule. The submittal shall include the name of the individual on the Contractor's staff who will be responsible for the CPM schedule and for providing the required updating information.

1.03 SUBMITTALS:

- A. Submit under provisions of Section 01 33 23.
- B. Within 10 days following the issuance of the Notice to Proceed, the Contractor shall submit the CPM Schedule to the Engineer for review and acceptance. The Contractor shall submit to the Engineer a preliminary network defining the planned operations during the first 60 calendar days after the issuance of the Notice to Proceed. The Contractor's general approach for the balance of the project shall be indicated. Cost of activities expected to be completed or partially completed before submission and approval of the complete network shall be included.

1.04 APPROVED CPM SCHEDULE:

- A. Following review by the Engineer, the Contractor shall incorporate the Engineer's comments into the network and submit the revised network and computer-generated schedule. This final submittal shall be delivered to the Engineer within 60 days after the issuance of the Notice to Proceed.
- B. CPM schedules, which contain activities showing negative, float or which extend beyond the contract completion date in the computer-generated schedule will not be approved.
- C. The approved network shall then be the approved CPM schedule to be used by the Contractor for planning, organizing and directing the work, and reporting progress.
- D. Approval of the CPM activity network by the Engineer is advisory only and shall not relieve the Contractor of responsibility for accomplishing the work within the contract completion date. Omissions and errors in the approved CPM schedule shall not excuse performance less than that required by the Contract. Approval by the Engineer in no way makes the Engineer an insurer of the CPM schedule's success or liable for time or cost overruns flowing from its shortcomings. The Owner hereby disclaims any obligation or liability by reason of approval by its agent, the Engineer, of the CPM schedule.
- E. The CPM activity network shall be submitted on sheets 24-in by 36-in and may be divided into as many separate sheets as required. An electronic file in PDF format shall be submitted concurrent with the hard copy schedule.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

3.01 NETWORK REQUIREMENTS:

- A. The network shall show the order and inter-dependence of activities and the sequence in which the work is to be accomplished as planned by the Contractor. The **basic concept of a network analysis diagram** shall be followed to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of following activities.
- B. Detailed network activities shall include: construction activities, the submittal and approval of shop drawings, the procurement of materials and equipment, fabrication of materials and equipment and their delivery, installation and testing, start-up and training. The Contractor shall break the work into activities with durations no longer than twenty working days each, except as to non-construction activities (such as procurement of materials and delivery of equipment) and any other activities for which the Engineer may approve the showing of longer duration. To the extent feasible, **activities related** to a specific physical area of the work should be grouped on the network for ease of understanding and simplification.

- C. Separate activities shall be provided for each significant identifiable function in each trade area in each facility. Activities shall be so identified that there will be no reasonable doubt as to how much work remains on each. Specific activities which shall be included are: all subcontract work, all interface work between subcontractors and between the Contractor and subcontractors, leakage tests of pipelines, electrical connections to each item of equipment, supplier and manufacturer technical assistance, mechanical connections to each item of equipment, all tests, concrete finishing, each item of site work, (including restraints on other activities) and all utilities, fuels and chemicals.
- D. Each activity on the network shall have the following indicated on the NODE representing it.
 - 1. A single duration (i.e., the single best estimate of elapsed time considering the scope of the work involved in the activity and the resources planned for accomplishing the activity) expressed in working days.
 - 2. A five character (or less) code indicative of the party responsible for accomplishing the activity.
 - 3. A cost estimate for each activity which, when accumulated with the cost of all activities, equals the total contract cost. Estimated overhead and profit shall be prorated throughout all activities. Materials costs shall be assigned to delivery activities.
 - 4. A brief description of the activity.
- E. The selection and number of activities shall be subject to the Engineer's approval. The detailed network need not be time scaled but shall be drafted to show a continuous flow from left to right with no flow from right to left. In addition to the brief description, the Contractor shall submit a separate list of all activities containing a detailed narrative of the scope of each activity, including the trades, subcontractors involved, and number of man-hours estimated.
- F. To the extent that the network or any revision thereof shows anything not jointly agreed upon or fails to show anything jointly agreed upon, it shall not be deemed to have been approved by the Engineer. Failure to include on a network any element of work required for the performance of this Contract shall not excuse the Contractor from completing all work required within any applicable completion date, notwithstanding the review of the network by the Engineer.
- G. Except where earlier completions are specified, CPM schedules, which show completion of all work prior to the contract completion date, may be approved by the Engineer but in no event shall they be acceptable as a basis for claim for delay against the Owner by the Contractor.

3.02 COMPUTER-GENERATED SCHEDULE REQUIREMENTS:

- A. Each computer-generated schedule submittal from the CPM activity network shall include the following tabulations: a list of activities in numerical order, a list of activity

precedence's, a schedule sequenced by Early Start Date and a schedule sequenced by Total Float. Each schedule shall include the following minimum items:

1. Activity numbers
2. Estimated duration
3. Activity description
4. Early start date (calendar dated)
5. Early finish date (calendar dated)
6. Latest allowable start date (calendar dated)
7. Latest allowable finish date (calendar dated)
8. Status (whether critical)
9. Estimated cost of the activity
10. Total float and free float

B. In addition, each schedule shall be prefaced with the following summary data:

1. Contract name and number
2. Contractor's Name
3. Contract duration
4. Contract schedule
5. The effective or starting date of the schedule.

C. The workday to calendar date correlation shall be based on an 8-hour day and 40-hour week with adequate allowance for holidays, adverse weather and all other special requirements of the work.

3.03 PROGRESS REPORTING:

A. Progress under the approved CPM schedule shall be evaluated monthly by the Contractor. Not less than seven days prior to each monthly progress meeting, The Contractor shall evaluate the status of each activity on which work has started or is due to start, based on the preceding CPM schedule; to **show actual progress**, to identify those activities started and those completed during the previous period, to show the estimated time required to complete or the percent complete of each activity started but not yet completed and to reflect any changes indicated for the network. Activities shall not be considered complete until they are, in fact, 100 percent complete.

- B. At each progress meeting the Contractor shall submit a narrative report based on the CPM schedule evaluation described above, in a format agreed upon by the Contractor and the Engineer. The report shall include a description of the progress during the previous period in terms of completed activities, an explanation of each activity which is showing a delay, a description of problem areas, current and anticipated delaying factors and their estimated impact on performance of other activities and completion dates and an explanation of corrective action taken or proposed. This report, as well as the CPM Status Report, will be discussed at each progress meeting.

3.04 RESPONSIBILITY FOR SCHEDULE COMPLIANCE:

- A. Whenever it becomes apparent from the current CPM schedule and narrative report that delays to the critical path have resulted and the contract completion date will not be met, the Contractor shall take some or all of the following actions at no additional cost to the Owner. He shall submit to the Engineer for approval, a written statement of the steps he intends to take to remove or arrest the delay to the critical path in the approved schedule.

3.05 ADJUSTMENT OF CONTRACT SCHEDULE AND COMPLETION TIME:

- A. If the Contractor desires to make changes in his method of operating which affect the approved CPM schedule, he shall notify the Engineer in writing stating what changes are proposed and the reason for the change. If the Engineer approves these changes, the Contractor shall revise and submit for approval, without additional cost to the Owner, all of the affected portions of the CPM network. The Contractor shall adjust the CPM schedule only after prior approval of his proposed changes by the Engineer.
- B. If the completion of any activity, whether or not critical, falls more than 100 percent behind its approved duration, the Contractor shall submit for approval a schedule adjustment showing each such activity divided into two activities reflecting completed versus uncompleted work.
- C. Shop drawings which are not approved on the first submittal or within the schedule time and equipment which do not pass the specified tests shall be immediately rescheduled.
- D. The contract time will be adjusted only for causes specified in this Contract. In the event the Contractor requests an extension of any contract completion date, he shall furnish such justification and supporting evidence as the Engineer may deem necessary to determine whether the Contractor is entitled to an extension of time under the provisions of this Contract. The Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If the Engineer finds that the Contractor is entitled to any extension of any contract completion date, the Engineer's determination as to the total number of day's extension shall be based upon the currently approved CPM schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule. Actual delays in activities, which, according to the CPM schedule, do not affect any contract completion date shown by the critical path in the network, will not be the basis for a change therein.
- E. Each request for change in any contract completion date shall be submitted by the

Contractor to the Engineer within 30 days after the beginning of the delay for which a time extension is requested but before the date of final payment under this Contract. No time extension will be granted for requests, which are not submitted within the foregoing time limit.

3.06 COORDINATING SCHEDULES WITH OTHER CONTRACT SCHEDULES:

- A. Where work is to be performed under this Contract concurrently with or contingent upon work performed on the same facilities or area under other contracts, the Contractor's CPM Schedule shall be coordinated with the schedules of the other contracts. The Contractor shall obtain the schedules of the other appropriate contracts from the Owner for the preparation and updating of his CPM schedule and shall make the required changes in his schedule when indicated by changes in corresponding schedules.
- B. In case of interference between the operations of different contractors, the Owner will determine the work priority of each Contractor and the sequence of work necessary to expedite the completion of the entire project. In all such cases, the decision of the Owner shall be accepted as final. The temporary delay of the Contractor's work due to such circumstances shall not be considered as justification for claims for additional compensation.

END OF SECTION

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SECTION 01 33 23

SUBMITTALS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall provide the Engineer with submittals as required by the contract documents.

1.02 RELATED WORK:

- A. Divisions 1 – 40 of these specifications that require submittals.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 GENERAL:

- A. As required by the General Conditions, Contractor shall submit a schedule of shop and working drawing submittals.
- B. The Contractor shall submit the shop and working drawing submittals either electronically or hard copy.

3.02 ELECTRONIC SUBMITTALS:

- A. In accordance with the accepted schedule, the Contractor shall submit promptly to the Engineer by email (butler.andrew@wseinc.com) or on Compact Disc (mail to Weston & Sampson Engineers, at 100 International Drive, Suite 152 attention: Andrew Butler), one electronic copy in Portable Document Format (PDF) of shop or working drawings required as noted in the specifications, of equipment, structural details and materials fabricated especially for this Contract.
- B. Each electronic copy of the shop or working drawing shall be accompanied by the Engineer's standard shop drawing transmittal form, included as Exhibit 1 of this section (use only for electronic submittals), on which is a list of the drawings, descriptions and numbers and the names of the Owner, Project, Contractor and building, equipment or structure.
- C. The Contractor shall receive a shop drawing memorandum with the Engineer's approval or comments via email.

3.03 HARD COPY SUBMITTALS:

- A. In accordance with the accepted schedule, the Contractor shall submit promptly to the Engineer, by mail (to Weston & Sampson Engineers, at 100 International Drive, Suite 152 attention: Andrew Butler), four (4) copies each of shop or working drawings required as noted in the specifications, of equipment, structural details and materials fabricated especially for this Contract.
- B. Each shipment of drawings shall be accompanied by the Engineer's (if applicable) standard shop drawing transmittal form on which is a list of the drawings, descriptions and numbers and the names of the Owner, Project, Contractor and building, equipment or structure.

3.04 SHOP AND WORKING DRAWINGS:

- A. Shop and working drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish of shop coat, grease fittings, etc., depending on the subject of the drawings. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for this Contract.
- B. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from his subcontractors and returning reviewed drawings to them. All shop and working drawings shall be prepared on standard size, 24-inch by 36-inch sheets, except those, which are made by changing existing standard shop or working drawings. All drawings shall be clearly marked with the names of the Owner, Project, Contractor and building, equipment or structure to which the drawing applies, and shall be suitably numbered. Each shipment of drawings shall be accompanied by the Engineer's (if applicable) standard shop drawing transmittal form on which is a list of the drawings, descriptions and numbers and the names mentioned above.
- C. Only drawings that have been prepared, checked and corrected by the fabricator should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself that the subject matter thereof conforms to the Contract Documents in all respects. Shop drawings shall be reviewed and marked with the date, checker's name and indication of the Contractor's approval, and only then shall be submitted to the Engineer. Shop drawings unsatisfactory to the Contractor shall be returned directly to their source for correction, without submittal to the Engineer. Shop drawings submitted to the Engineer without the Contractor's approval stamp and signature will be rejected. Any deviation from the Contract Documents indicated on the shop drawings must be identified on the drawings and in a separate submittal to the Engineer, as required in this section of the specifications and General Conditions.
- D. The Contractor shall be responsible for the prompt submittal and resubmittal, as necessary, of all shop and working drawings so that there will be no delay in the work

due to the absence of such drawings.

- E. The Engineer will review the shop and working drawings as to their general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections of comments made on the drawings during the review do not relieve the Contractor from compliance with requirements of the Contract Documents. The Contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. The review of the shop drawings is general and shall not relieve the Contractor of the responsibility for details of design, dimensions, code compliance, etc., necessary for interfacing with other components, proper fitting and construction of the work required by the Contract and for achieving the specified performance. The Engineer will review submittals two times: once upon original submission and a second time if the Engineer requires a revision or corrections. The Contractor shall reimburse the Owner amounts charged to the Owner by the Engineer for performing any review of a submittal for the third time or greater.
- F. With few exceptions, shop drawings will be reviewed and returned to the Contractor within 30 days of submittal.
- G. No material or equipment shall be purchased or fabricated especially for this Contract, nor shall the Contractor proceed with any portion of the work, the design and details of which are dependent upon the design and details of equipment or other features for which review is required, until the required shop and working drawings have been submitted and reviewed by the Engineer as to their general conformance and compliance with the project and its Contract Documents. All materials and work involved in the construction shall then be as represented by said drawings.
- H. Two copies of the shop and working drawings and/or catalog cuts will be returned to the Contractor. The Contractor shall furnish additional copies of such drawings or catalog cuts when he needs more than two copies or when so requested.

3.05 SAMPLES:

- A. Samples specified in individual Sections include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and units of work to be used by the Engineer or Owner for independent inspection and testing, as applicable to the work.
- B. The number of samples submitted shall be as specified. Submittal and processing of samples shall follow the procedures outlined for shop and working drawings unless the specifications call for a field submittal or mock-up.

- C. Acceptance of samples will be acknowledged via a copy of the transmittal noting status. When samples are not acceptable, prompt resubmittal will be required.

3.06 OPERATING AND MAINTENANCE MANUALS AND SPARE PARTS LISTS:

- A. Submit operation and maintenance manuals and spare parts lists in accordance with Section 01 33 23.13 SUBMITTAL OF OPERATION AND MAINTENANCE MANUALS.

END OF SECTION

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EXHIBIT 1 TO SECTION 01 33 23 SUBMITTALS
SHOP DRAWING TRANSMITTAL FORM

Shop Drawing Transmittal				Weston & Sampson Engineers, Inc.					
Instruction for Preparing Transmittal No action will be taken on any item unless accompanied by this form. TRANSMITTAL NOS. to be consecutive (1, 2, 3, etc.). Each resubmittal of same item shall use same number with suffix letter (A, B, etc.). SPEC. SECT. NO: Only one spec. section no. to each transmittal. DESCRIPTION: Complete identification of document or group of documents. SOURCE: Originator of document(s) being submitted.				DRAWING NO: Identification of document(s). CONTRACT DRAWING REFERENCE: Contract drawing number(s) showing details of document(s). SPECIAL INSTRUCTIONS: Special cases and emergencies, changes in distribution and special handling requests, etc. should be entered here. SIGNATURE OF CONTRACTOR: Signature of individual who reviews and approves material prior to submittal to engineer.					
THIS SECTION TO BE COMPLETED BY CONTRACTOR									
TRANSM. NO.		SPEC. SECT. NO.		DATE		CONTRACTORS JOB NO.	W&S JOB NO.		
							ENG23-0367		
PROJECT NAME & CONTRACT NO.				LOCATION					
Ledgeview Sewer Pump Station Upgrade				Rochester, New Hampshire					
T O	Weston & Sampson Engineers, Inc. 100 International Drive, Suite 152 Portsmouth, NH 03801			F R O M					
						BY W&S			
ITEM NO.	DESCRIPTION			SOURCE	DRAWING NO. CATALOG NO. BROCHURE, ETC	NO. OF COPIES	CONTRACT DRAWING REF.	ACTION CODE	REVIEWED BY
1									
2									
3									
4									
THIS CERTIFIES THAT ALL ITEMS SUBMITTED HEREWITH HAVE BEEN CHECKED BY THE CONTRACTOR, ARE IN CONFORMANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, EXCEPT AS NOTED, AND ARE APPROVED BY THE CONTRACTOR FOR THIS PROJECT.						SIGNATURE & TITLE			
THIS SECTION TO BE COMPLETED BY W&S									
ACTION CODE: 1. FURNISH AS SUBMITTED 2. FURNISH AS NOTED 3. REVISE AND RESUBMIT 4. REJECTED- SEE REMARKS 5. ACKNOWLEDGEMENT 6. SUBMITTAL NOT REQUIRED, RETURNED WITHOUT REVIEW						a. INSTALLATION SHALL PROCEED ONLY WHEN ACTION CODE IS 1 OR 2 b. ACTION CODED 3 SHALL BE RESUBMITTED WITHIN TIME LIMIT SET IN CONTRACT c. REVIEW DOES NOT RELIEVE CONTRACTOR FROM RESPONSIBILITY OF COMPLIANCE WITH ALL REQUIREMENTS OF THE CONTRACT DOCUMENTS		Weston & Sampson Engineers, Inc.	

SECTION 01 33 23.13

SUBMITTAL OF OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL:

1.01 OPERATION AND MAINTENANCE MANUALS:

- A. As required by the General Conditions, and Section 01 92 13 OPERATION AND MAINTENANCE MANUALS and Technical Specifications, the Contractor shall submit a schedule of Operation and Maintenance Manuals.
- B. In accordance with the schedule, the Contractor shall submit promptly to the Engineer, through its authorized resident representative at the job site, or by mail, attention: TLD, six (6) copies each of Operation and Maintenance Manual required as noted in the technical specifications sections for this Contract.
- C. The manuals shall be prepared in accordance with Specification Section 01 92 13 - OPERATION AND MAINTENANCE MANUALS.
- D. Such manuals shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawings.
- E. All manuals shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining manuals from his subcontractors and returning reviewed manuals to them. A Weston & Sampson standard shop drawing transmittal form with a description of the manual shall accompany each shipment of manuals.
- F. The Contractor shall be responsible for the prompt submittal and resubmittal, as necessary, of all manuals so that there will be no delay in the startup operation of the facility due to the absence of such manuals.
- G. The Engineer will review the manuals as to their general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections of comments made in the manuals during the review does not relieve the Contractor from compliance with requirements of the Contract Documents.
- H. With few exceptions, O&M Manuals will be reviewed and returned to the Contractor within 30 days of submittal.

1.02 RELATED WORK:

- A. Section 01 33 23 SUBMITTALS
- B. Section 01 78 00 PROJECT CLOSEOUT
- C. Section 01 92 13 OPERATION AND MAINTENANCE MANUALS

- 1.03 SUBMITTAL OF OPERATION AND MAINTENANCE MANUALS AND SPARE PARTS LISTS:
- A. Where reference is made in technical specification sections to operating and maintenance manuals and/or spare parts lists, the Contractor shall submit four copies to the Engineer for review in accordance with the following instructions:
1. Four complete sets of operation and maintenance instructions covering all equipment furnished under Sections 23, 26, 33, and 40 requiring operation and maintenance manuals shall be delivered directly to Weston & Sampson Engineers, Inc, 100 International Drive, Suite 152, Portsmouth New Hampshire, 03801, Attention: Griffin Parodi.
 2. Submission and approval of each set of manuals is considered an integral part of furnishing and installing respective equipment or systems. Measurement for payment of equipment requiring an operation and maintenance manual will not exceed 92 percent, until the manuals meet the requirements of the contract documents.
 3. Submit four copies of first draft volumes as required in Specification Sections 01 33 23.13 and 01 92 13. This first draft shall contain all currently available product data. One copy will be returned with comments.
 4. Submit four copies of completed second draft volumes in final form 90 days prior to startup and after Physical checkout to include the additional requirements set forth in paragraph 1.07.R of Section 01 92 13 OPERATION AND MAINTENANCE MANUALS.
 5. Submit four copies of the Final Operation and Maintenance Manuals as required in Section 01 78 00 PROJECT CLOSEOUT.
- B. If the submittal is complete and does not require any changes, an acknowledgement (copy of transmittal) will be returned noting status. If the submittal is incomplete or does require changes, corrections, additions, etc., one copy of the submittal will be returned with a copy of transmittal noting status.
- C. For systems requiring field adjustment and balancing, such as heating and ventilating, the Contractor shall submit separate test results and adjustment data on completion of the work, to be incorporated into the system manual.
- D. The information included in the manual shall be as described in the individual specification sections, but as a minimum shall contain clear and concise instructions for operating, adjusting, lubricating and maintaining the equipment, an exploded assembly drawing, identifying each part by number and a listing of all parts of the equipment, with part numbers and descriptions required for ordering spare parts. Spare parts lists shall include recommended quantity and price.

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

Not used.

END OF SECTION

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SECTION 01 45 23

STRUCTURAL TESTS AND INSPECTIONS

PART 1 - GENERAL

The term “Contractor” or “General Contractor” as used in the Division 00, Division 01 and all Technical Specification Sections shall be synonymous with the installing contractor for which the work is applicable to, unless noted otherwise.

1.01 WORK INCLUDED:

- A. Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Obtaining, coordinating, and providing notifications to the Owner and Engineer.
 - 2. Provide safe access to the work of this Contract to accommodate the indicated tests and inspections.
 - 3. Implementing corrective action and providing additional tests and/or inspections for work identified as non-conforming by the Independent Testing Agency.

1.02 GENERAL REQUIREMENTS:

- A. The New Hampshire State Building Code (2015 International Building Code), requires the Structural Engineer of Record (SER) to provide a program of structural tests and inspections for this project.
- B. Attachment A, Program of Structural Tests and Inspections, shall not relieve the Contractor or its subcontractors of their responsibilities and obligations for quality control of the Work; their other obligations for supervising the Work; for any design work which is included in their scope of services; for full compliance with the requirements of the Contract Documents; the detection of, or failure to detect, deficiencies or defects, whether detected or undetected, in all parts of the Work, and to otherwise comply with all requirements of the Contract Documents.
- C. The Program of Structural Tests and Inspection does not apply to the Contractor’s equipment, temporary structures used by the Contractor to construct the project, the Contractor’s means, methods, procedures, and job site safety.

1.03 CONTRACTOR RESPONSIBILITIES:

- A. The Contractor shall provide free and safe access to the Work for the SER and all other individuals who are observing the Work or performing structural tests or inspections. The Contractor shall provide all ladders, scaffolding, staging, and up-to-date safety equipment, all in good and safe working order, and qualified personnel to handle and erect them, as may be required for safe access.
- B. The Contractor shall give reasonable notice to the Owner and the Engineer of when the various parts of the Work will be ready for testing and/or inspection. The Contractor shall notify the Owner and the Engineer a minimum of 48 hours before such tests and/or inspections are to take place.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

ATTACHMENT A

PROGRAM OF STRUCTURAL TESTS AND INSPECTIONS

The following is a summary of Work subject to Tests and Inspections under the Program.

1. In-situ Bearing Strata for Footings
2. Controlled Structural Fill
3. Cast-In-Place Concrete
4. Masonry (Not Used)
5. Structural Steel

Abbreviation Agent

SER Structural Engineer of Record

ITA Contractor – Independent Testing Agency

In-Situ Bearing Strata for Footings

Item	Agent	Scope
1. Bearing Strata QC Review	ITA	Review Contractor's field quality control procedures.
2. General Excavation	ITA	Inspect strata for conformance to the structural drawings, specifications, and/or geotechnical report.
3. General Excavation	ITA	Ensure that excavation is to proper depth or material.
4. General Excavation	ITA	Ensure that excavation is controlled and contains no unsuitable materials.
5. Bearing surfaces for footings	ITA	Inspect bearing surfaces for conformance to the requirements of the structural drawings, specifications, and/or geotechnical report.

Controlled Structural Fill

Item	Agent	Scope
1. Controlled Structural Fill QC Review	SER	Review Contractor's field quality control procedures
2. Fill Material	ITA	Test material for conformance to specifications or geotechnical report. Perform laboratory compaction tests in accordance with the specifications to determine optimum water content and maximum dry density.
3. Installation of controlled structural fill	ITA	Provide full-time inspection of the installation, in accordance with the specifications.
4. Density of Fill	ITA	Perform field density tests of the in-place fill in accordance with the specifications.

Cast-In-Place Concrete Construction

Item	Agent	Scope
1. Cast-In-Place Concrete Construction QC Review	SER	Review Contractor's field quality control procedures. Review frequency and scope of field testing and inspections.
2. Mix Design	SER	Review Mix Designs
3. Materials	SER	Review material certifications for conformance to Specifications
4. Batching Plant	ITA	Review Plant quality control procedures and batching and mixing methods
5. Reinforcement Installation	ITA	Inspect reinforcing for size, quantity, condition and placement
6. Anchor Rods	ITA	Inspect anchor rods prior to and during placement of concrete.
6. Formwork	ITA	Inspect form sizes for proper sizes of concrete members.
7. Concrete Placement and Sampling fresh Concrete	ITA	Observe concrete placement operations. Verify conformance to specifications including cold-weather and hot-weather placement procedures. Perform slump, density and air content tests at point of discharge.
8. Evaluation of Concrete	ITA	Test and evaluate in accordance with the specifications.
9. Curing and Protection	ITA	Observe procedures for conformance to the specifications.

Masonry Construction

Item	Agent	Scope
Not used		

Structural Steel

Item	Agent	Scope
1. Fabricator Certification/Quality Control Procedures	SER	Review Contractor's field quality control procedures. Review frequency and scope of field testing and inspections.
2. Fabricator Certification/Quality Control Procedures	SER	Review each Fabricator's quality control procedures.
3. Fabricator Inspection	SER	Inspect in-plant fabrication, or review Fabricator's approved Independent Inspection Agency's reports.
4. Materials	SER	Review materials certifications for conformance to the specifications.
5. Anchor Rods	SER	Review Contractor's as-built survey.
6. Anchor Rods	ITA	Verify that all anchor rods have been properly torqued and have adequate fit-up.
7. Bolting	ITA	Test and inspect bolted connections in accordance with specifications. Verify bolt size and grade.
8. Welding	ITA	Check welder qualifications. Visually inspect fillet welds and test full penetration field welds in accordance with specifications
9. Shear Connectors	ITA	Inspect for size and placement. Test for proper weld attachment
10. Structural Framing, Details, and Assembly	ITA	Inspect for size, grade of steel, camber, installation and connection details. Check against Contract Documents and approved shop drawings.
11. Metal Decking	ITA	Verify gage, width, and type. Inspect placement, laps, welds, side laps attachment and screws or other mechanical fasteners. Check welder qualifications.

Structural Steel cont'd

12. Expansion and Adhesive Anchors	SER	Review installation procedures for both mechanical anchors and adhesive anchors. Verify that materials are suitable for job conditions.
13. Field Correction of Fabricated Items	ITA	Review documentation of approved repairs and verify completion of repairs.

END OF SECTION

SECTION 01 56 26

TEMPORARY CHAIN LINK FENCE

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall provide all labor, materials and appurtenances necessary for the installation, maintenance and dismantling of 8-foot temporary fencing.
- B. The Contractor shall be responsible for securing the site from trespassers. Existing fencing exists on portions of the site as shown on the Contract Drawings; it will be at the discretion of the Contractor to determine whether the existing fence is suitable for site safety and security. The Contractor shall install temporary fencing across lengths of damaged/unsuitable fencing to secure the site and prevent trespassers.

1.02 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer's literature of the materials specified herein.
- B. Shop drawings of the temporary chain link fence and gates.
 - 1. Shop drawings shall indicate layout of temporary fencing, location and size of gates, existing pavement and roads, and other site-specific conditions. Prepare drawing after site observation and verification of existing conditions.

PART 2 - PRODUCTS

2.01 TEMPORARY CHAIN LINK FENCING

- A. Unless otherwise indicated, type of 8-foot temporary chain link fencing shall be Contractor's option. Following types are acceptable:
 - 1. New materials or previously used salvaged chain link fencing in good condition.
 - 2. Posts: Galvanized steel pipe of diameter to provide rigidity. Post shall be suitable for setting in concrete footings, driving into ground, anchoring with base plates, or inserting in precast concrete blocks.
 - 3. Fabric: Woven galvanized steel wire mesh. Provide in continuous lengths to be wire tied to fence posts or prefabricated into modular pipe-framed fence panels.
- B. Gates: Provide gates of the quantity and size indicated on the Contract Drawings or required for functional access to Site.

1. Fabricate of same material as used for fencing.
2. Vehicle gates:
 - a. Minimum width: 20 feet to allow access for emergency vehicles.
 - b. Capable of manual operation by one person.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The fence and gates shall be erected by skilled mechanics in accordance with the recommendations of the manufacturer and these specifications. These specifications shall take precedence over the recommendations of the manufacturer if any discrepancy exists between them.
- B. Posts
 1. Maximum post spacing shall be 10-feet. Post spacing shall be uniform and posts shall be plumb.
 2. Drive posts, set in holes and backfill, or anchor in precast concrete blocks.
 3. For soft and unstable ground conditions, cast concrete plug around post.
 4. Posts over pavement: Use steel post plates or precast concrete blocks.
 5. Gate posts: Use bracing or concrete footings to provide rigidity for accommodating size of gate.
 6. Temporary terminal posts shall be securely connected to existing fence posts to prevent site access/trespassing.
- C. Securely attach wire fabric to posts. Maximum area of unbraced fence fabric shall not exceed 1,500 square feet.
- D. Install with required hardware.
- E. Fabric shall be stretched taut, with the bottom edge following the existing grade, and shall be a continuous mesh between terminal posts. Each span of fabric shall be attached independently at terminal posts. Where terminal posts do not have provisions for weaving fabric to posts, stretcher bars shall be placed through the end weave of the fabric and secured to the post with bar bands spaced not more than 15-inches apart on the post. Temporary terminal posts shall be secured to existing fence posts to prevent Site access/trespassing.

- F. Fabric shall be attached with ties to line posts at intervals of not more than 14-inches (and to the top railing and braces at intervals not exceeding 24-inches).
- G. The bottom tension wire shall be interlaced in the weave of the fabric, pulled taut and fastened to terminal posts.

3.02 MAINTENANCE AND REMOVAL

- A. Maintain fencing in good condition. If damaged, immediately repair.
- B. Remove temporary fencing upon completion of Work or when no longer required for security or control. Backfill holes and compact. Holes in pavement shall be surfaced to match existing paving. Repair damage caused by installation of temporary fencing.

END OF SECTION

\\Wse03.local\WSE\Projects\NH\Rochester, NH\ENG23-0367 Ledgeview PS Final Design\090 - Specifications\Division 01 - General Requirements\01 56 26 Temporary Chain Link Fence.docx

SECTION 01 57 19

ENVIRONMENTAL PROTECTION

PART 1 – GENERAL

1.01 DESCRIPTION:

- A. The work covered by this section of the specifications consists of furnishing all labor, materials, tools and equipment and performing all work required for the prevention of environmental pollution during and as a result of construction operations under this contract.
- B. The requirements set forth in this section of the specifications apply to cross-country areas, river and stream crossings, and construction in and adjacent to wetlands, unless otherwise specifically stated.
- C. All work under this Contract shall be in accordance with the Conservation Commissions' Orders of Conditions as well as any conditional requirements applied, all of which are attached to Section 00 31 43, PERMITS.
- D. Prior to commencement of work, the Contractor shall meet with representatives of the Engineer to develop mutual understandings relative to compliance of the environmental protection program.

1.02 RELATED WORK:

- A. Section 00 31 43, PERMITS
- B. Section 01 14 19.16, DUST CONTROL
- C. Section 01 33 23, SUBMITTALS
- D. Section 31 00 00, EARTHWORK
- E. Section 31 23 19, DEWATERING
- F. Section 31 50 00, SUPPORT OF EXCAVATION

1.03 SUBMITTALS:

- A. The Contractor shall submit details and literature fully describing environmental protection methods to be employed in carrying out construction activities within 100 feet of wetlands or across areas designated as wetlands.

PART 2 - PRODUCTS

2.01 SILT FENCE:

- A. The silt fence shall consist of a 3-foot wide continuous length sediment control fabric, stitched to a mesh backing, and stapled to preweathered oak posts installed as shown on the drawings. The oak posts shall be 1-1/4-inches by 1-1/4-inches (Minimum Dimension) by 48-inches and shall be tapered. The bottom edge of the silt fence shall be buried as shown on the drawings.
- B. The silt fence shall be DOT Silt Fence PPDM3611, as manufactured by U.S. Silt & Site Supply/Getsco, Concord, NH, or approved equal.
- C. Silt fence properties:

<u>Physical Properties</u>	<u>Test Method</u>	<u>Minimum Value</u>
Grab Strength, lbs.	ASTM-D-4632	124
Grab Elongation, %	ASTM-D-4632	15
Mullen burst, psi	ASTM-D-3786	300
Puncture, lbs.	ASTM-D-4833	65
Trapezoidal Tear, lbs.	ASTM-D-4533	65
UV Resistance ² , % ³	ASTM-D-4355	80@500 hrs.
AOS, US Sieve No.	ASTM-D-4751	30
Flow Rate, gal/min/sq ft	ASTM-D-4491	10
Permittivity,(1/sec)gal/min/sq ft	ASTM-D-4491	0.05 sec ⁻¹

2.02 STRAW BALES:

- A. Straw bales shall consist of certified seed free stems of agricultural grain and cereal crops and shall be free of grasses and legumes. Standard bales shall be 14-inches high, 18- inches wide and 36- to 40-inches long tied with polypropylene twine and weigh within 5 percent of 7 lbs. per cubic ft.

2.03 STRAW WATTLES:

- A. Straw Wattles shall consist of a 100% biodegradable exterior jute or coir netting with 100% wheat straw interior filling as manufactured by GEI Works, Sebastian, Florida (Phone: 772-646-0597; website: www.erosionpollution.com), or approved equal.

2.04 CATCH BASIN PROTECTION:

- A. To trap sediment and to prevent sediment from clogging drainage systems, catch basin protection in the form of a siltation sack (Siltsack as manufactured by ACF Environmental, Inc. or approved equal) shall be provided as approved by the Engineer.

PART 3- EXECUTION

3.01 NOTIFICATION AND STOPPAGE OF WORK:

- A. The Engineer will notify the Contractor in writing of any non-compliance with the provisions of the Order of Conditions. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails to act promptly, the Owner may order stoppage of all or part of the work through the Engineer until satisfactory corrective action has been taken. No claim for an extension of time or for excess costs or damage incurred by the Contractor as a result of time lost due to any stop work orders shall be made unless it was later determined that the Contractor was in compliance.

3.02 AREA OF CONSTRUCTION ACTIVITY:

- A. Insofar as possible, the Contractor shall confine his construction activities to those areas defined by the plans and specifications. All land resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their present condition or be restored to a condition after completion of construction at least equal to that which existed prior to work under this contract.

3.03 LOCATION OF STORAGE AREAS:

- A. The location of the Contractor's storage areas for equipment and/or materials shall be upon cleared portions of the job site or areas to be cleared as a part of this project, and shall require written approval of the Engineer. Plans showing storage facilities for equipment and materials shall be submitted for approval of the Engineer.
- B. No excavated materials or materials used in backfill operations shall be deposited within a minimum distance of one hundred (100) feet of any watercourse or any drainage facility. Adequate measures for erosion and sediment control such as the placement of baled straw around the downstream perimeter of stockpiles shall be employed to protect any downstream areas from siltation.
- C. There shall be no storage of equipment or materials in areas designated as wetlands.
- D. The Engineer may designate a particular area or areas where the Contractor may store materials used in his operations.
- E. Storage areas in cross-country locations shall be restored to pre-construction conditions with the planting of native species of trees and shrubs.

3.04 CLEARING AND GRUBBING:

- A. The Contractor shall clear and grub only on the Owner's land or the Owner's easements, and only the area required for construction operations, as approved by the Engineer. Removal of mature trees (4-inches or greater DBH) will not be allowed on temporary easements.
- B. The Contractor shall not remove trees in the Owner's temporary easements without permission of the Engineer.

3.05 DISCHARGE OF DEWATERING OPERATIONS:

- A. Any water that is pumped and discharged from the trench and/or excavation as part of the Contractor's water handling shall be filtered by an approved method prior to its discharge into a receiving water or drainage system.
- B. Under no circumstances shall the Contractor discharge water to the areas designated as wetlands. When constructing in a wetlands area, the Contractor shall discharge water from dewatering operations directly to the nearest drainage system, stream, or waterway after filtering by an approved method.
- C. The pumped water shall be filtered through filter fabric and baled hay, a vegetative filter strip or a vegetated channel to trap sediment occurring as a result of the construction operations. The vegetated channel shall be constructed such that the discharge flow rate shall not exceed a velocity of more than 1 foot per second. Accumulated sediment shall be cleared from the channel periodically.

3.06 DUST CONTROL:

- A. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, to minimize creation and dispersion of dust. If the Engineer decides it is necessary to use calcium chloride for more effective dust control, the Contractor shall furnish and spread the material, as directed. Calcium chloride shall be as specified under Section 01 14 19.16, DUST CONTROL.
- B. Calcium Chloride shall not be used for dust control within a drainage basin or in the vicinity of any source of potable water.

3.07 BALED STRAW:

- A. To trap sediment and to prevent sediment from clogging drainage systems, baled straw shall be used where shown on the drawings. Care shall be taken to keep the bales from breaking apart. The bales should be securely staked to prevent overturning, flotation, or displacement. All deposited sediment shall be removed periodically. Straw bales shall not be placed within a waterway during construction of the pipeline crossing.

3.08 ERECTION AND MAINTENANCE OF SILT FENCE:

- A. Where indicated on the drawings or where required by the Engineer, the Contractor shall erect and maintain a temporary silt fence. In areas designated as wetlands, the Contractor shall line the limits of the construction easement with a silt fence. The silt fence shall be used specifically to contain sediment from runoff water and to minimize environmental damage caused by construction.

3.09 CATCH BASIN PROTECTION:

- A. Catch basin protection shall be used for every catch basin, shown on the plans or as required by the Engineer, to trap sediment and prevent it from clogging drainage systems and entering wetlands. Siltation sack shall be securely installed under the catch basin grate. Care shall be taken to keep the siltation sack from breaking apart or clogging. All deposited sediment shall be removed periodically and at times prior to predicted precipitation to allow free drainage flow. Prior to working in areas where catch basins are to be protected, each catch basin sump shall be cleaned of all debris and protected. The Contractor shall properly dispose of all debris at no additional cost to the Owner.
- B. All catch basin protection shall be removed by the Contractor after construction is complete.

3.10 STRAW WATTLES:

- A. The wattles will be placed in a shallow trench (2-3 inches deep) and staked in the ground using wooden stakes driven at 4-foot intervals. The wooden stakes will be placed at a minimum depth of 24-inches into the ground.
- B. The wattles shall be regularly inspected and before and after every forecasted major weather event. All deposited sediment shall be removed and not allowed to accumulate to the top of the wattles. Wattles damaged during construction shall be repaired or replaced as required by the Engineer at no additional cost to the Owner.
- C. The Contractor shall remove all wattles after construction is completed.

END OF SECTION

SECTION 01 73 29

CUTTING, CORING AND PATCHING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the cutting, coring, rough and finish patching of holes and openings in existing structures.

1.02 RELATED WORK:

A. SECTION 03 30 00 CAST-IN-PLACE CONCRETE

PART 2 - PRODUCTS

2.01 SEALING MATERIALS:

- A. Mechanical seals shall be modular, adjustable, bolted, mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. The seal shall be rated by the manufacturer for 40 feet of head or 20 psig. Mechanical seals shall be Link-Seal, manufactured by Thunderline Corp., Wayne, MI., or approved equal.
- B. Sealant shall be a two part foamed silicone elastomer as manufactured by Dow Corning Co., product No. 3-6548 silicone R.T.V.; 3M brand fire barrier products caulk C.P. 25 and 3M brand putty 303; Flame-Safe fire stop systems Fig. No. FS-500 by Thomas & Betts Corporation, or approved equal. Packing shall be a fire retardant pliable material, Fig. 310 by Sealtite Co.; White Oakum W.S.-600 by American Manufacturing Co., or approved equal. Sealant bead configuration, depth and width shall be in accordance with manufacturer's recommendations.

2.02 MISCELLANEOUS MATERIALS:

- A. Bonding compound shall be Sikadur Hi-Mod epoxy by Sika Corporation, or equivalent by Euclid Chemical Corporation, Master Builders Company, or approved equal.
- B. Non-shrink grout shall be Masterflow 713 by Master Builders Company; Euco N-S by Euclid Chemical Co.; Five Star Grout by U.S. Grout Corp. or approved equal.
- C. Materials for finish patching shall be equal to those of adjacent construction.

PART 3 - EXECUTION

3.01 GENERAL:

- A. The Contractor shall leave all chases or openings for the installation of his own or any other contractor's or subcontractor's work, or shall cut the same in existing work, and shall see that all sleeves or forms are at the work and properly set in ample time to prevent delays. He shall see that all such chases, openings, and sleeves are located accurately and are of proper size and shape and shall consult with the Engineer and the contractors and subcontractors concerned in reference to this work.
- B. In case of his failure to leave or cut all such openings or have all such sleeves provided and set in proper time, Contractor shall cut them or set them afterwards at his own expense, but in so doing he shall confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall piers or structural members be cut without the written consent of the Engineer.
- C. The Contractor shall not cut or alter the work of any subcontractor or any other contractor, nor permit any of his subcontractors to cut or alter the work of any other contractor or subcontractor, except with the written consent of the contractor or subcontractor whose work is to be cut or altered or with the written consent of the Engineer. All cutting and patching or repairing made necessary by the negligence, carelessness, or incompetence of the Contractor or any of his subcontractors shall be done by or at the expense of the Contractor and shall be the responsibility of the Contractor.
- D. All cutting and coring shall be performed in such a manner as to limit the extent of patching.
- E. All holes cut through concrete and masonry walls, slabs or arches shall be core drilled unless otherwise approved. No structural members shall be cut without the approval of the Engineer and all such cutting shall be done in a manner required by him. No holes may be drilled in beams or other structural members without obtaining prior approval. All work shall be performed by mechanics skilled in this type of work.

3.02 CORING:

- A. Coring shall be performed with an approved non-impact rotary tool with diamond core drills. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.
- B. If holes are cored through floor slabs they shall be drilled from below.
- C. All equipment shall conform to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring and maintenance.
- D. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.

- E. Slurry or tailings resulting from coring operations shall be vacuumed or otherwise removed from the area following drilling.

3.03 CUTTING:

- A. Cutting shall be performed with a concrete saw and diamond saw blades of proper size and application.
- B. Provide for control of slurry generated by sawing operation on both sides of wall or slab.
- C. When cutting a reinforced concrete wall, the cutting shall be done so as not to damage bond between the concrete and reinforcing steel left in the structure. Cut shall be made so that steel neither protrudes nor is recessed from the face of the cut.
- D. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.
- E. Provide equipment of adequate size to remove cut panel.
- F. For cutting a trench in a floor slab, a full-depth cut shall be made using a concrete saw for the desired width of the trench. A partial-depth cut shall be made to expose the reinforcing bars. The width of the partial cut shall be to the required lap length of the reinforcing bars. Care shall be taken not to cut exposed reinforcing bars but if any are cut, dowel holes shall be drilled and dowels epoxied in. Reinforcing of the same size, as the existing shall be tied to the existing exposed reinforcing and/or dowels with the proper lap length.

3.04 PATCHING:

Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown. Finish patching shall match existing surfaces as approved.

Trenches in floor slabs shall be repaired as described in 3.03F above and concrete meeting the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE shall be poured and cured.

END OF SECTION

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SECTION 01 74 13

CLEANING UP

PART 1 - GENERAL

1.01 DESCRIPTION:

The Contractor must employ at all times during the progress of its work adequate cleanup measures and safety precautions to prevent injuries to persons or damage to property. The Contractor shall immediately, upon request by the Engineer provide adequate material, equipment and labor to cleanup and make safe any and all areas deemed necessary by the Engineer.

1.02 RELATED WORK:

- A. Section C – 1.1 GENERAL CONDITIONS
- B. Section 01 11 00 CONTROL OF WORK AND MATERIALS
- C. Section 01 14 00 SPECIAL PROVISIONS
- D. Section 01 57 19 ENVIRONMENTAL PROTECTION

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

3.01 DAILY CLEANUP:

- A. The Contractor shall clean up, at least daily, all refuse, rubbish, scrap and surplus material, debris and unneeded construction equipment resulting from the construction operations and sweep the area. The site of the work and the adjacent areas affected thereby shall at all times present a neat, orderly and workmanlike appearance.
- B. Upon written notification by the Engineer, the Contractor shall within 24 hours clean up those areas, which in the Engineer's opinion are in violation of this section and the above referenced sections of the specifications.
- C. If in the opinion of the Engineer, the referenced areas are not satisfactorily cleaned up, all other work on the project shall stop until the cleanup is satisfactory.

3.02 MATERIAL OR DEBRIS IN DRAINAGE FACILITIES:

- A. Where material or debris has washed or flowed into or has been placed in existing watercourses, ditches, gutters, drains, pipes, structures, such material or debris shall be entirely removed and satisfactorily disposed of during progress of the work, and the ditches, channels, drains, pipes, structures, and work shall, upon completion of the work, be left in a clean and neat condition.

3.03 REMOVAL OF TEMPORARY BUILDINGS, STRUCTURES AND EQUIPMENT:

- A. On or before completion of the work, the Contractor shall, unless otherwise specifically required or permitted in writing, tear down and remove all temporary buildings and structures it built; shall remove all temporary works, tools and machinery or other construction equipment it furnished; shall remove all rubbish from any grounds which it has occupied; shall remove silt fences and hay bales used for trapping sediment; and shall leave the roads and all parts of the property and adjacent property affected by its operations in a neat and satisfactory condition.

3.04 RESTORATION OF DAMAGED PROPERTY:

- A. The Contractor shall restore or replace, when and as required, any property damaged by its work, equipment or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the Contractor shall do as required all necessary highway or driveway, walk and landscaping work. Materials, equipment, and methods for such restoration shall be as approved by the Engineer.

3.05 FINAL CLEANUP:

- A. Before acceptance by the Owner, the Contractor shall perform a final cleanup to bring the construction site to its original or specified condition. This cleanup shall include removing all trash and debris off of the premises. Before acceptance, the Engineer shall approve the condition of the site.
- B. Before acceptance by the Owner, the Contractor shall perform a final cleanup to bring the building to a "like new" condition. This cleanup shall include removing all trash and debris from the premises; sweeping and mopping of all floors; washing of all walls, windows and doors; cleaning and polishing of all finish metal surfaces; cleaning of all equipment, utilizing proper solvents for removal of oil and grease; cleaning of dirt and debris out of all mechanical and electrical cabinets; and all other related work required to render the building suitable for use. Before acceptance, the Engineer shall approve the condition of the building.

END OF SECTION

SECTION 01 75 00

STARTUP AND TESTING FOR SEWER PUMP STATIONS

PART 1 – GENERAL

1.01 WORK INCLUDED:

- A. This Section covers the startup and testing services required for the pump station(s) during system startup as specified herein.

1.02 RELATED WORK:

- A. Section 01 33 23.13 – SUBMITTAL OF OPERATION & MAINTENANCE MANUALS
- B. Divisions 23-40

1.03 SYSTEM DESCRIPTION:

- A. The Contractor shall perform pump station startup to the satisfaction of the Engineer. Startup and testing shall not be initiated until all required certifications and other required documentation has been submitted, as described herein.
- B. The purpose of the startup test is to provide a final operational checkout of all equipment prior to beneficial use by the Owner. This shall include both manual and automatic operation as well as instrumentation and alarm operations and simulations.
- C. This startup and testing is not to be utilized as a general debugging of the system. All equipment shall be started, tested, balanced, and calibrated prior to conducting the startup and testing described in this specification section. All the following equipment shall be tested prior to performing the actual acceptance test:
 - a. Pumps and Motors
 - b. Telemetry Equipment
 - c. Instrumentation and Alarms
 - d. Liquid Level Controls
 - e. Standby Engine and Backup Control System
 - f. Miscellaneous Equipment – HVAC, portable generator transfer switch, etc.
- D. As most components of each pump station are interrelated, Substantial Completion of the project shall not be certified until successful completion of startup.

1.04 SEQUENCING:

- A. Startup, testing, operator training and other like services to be provided under the technical sections of the specifications are not to be performed during startup without

written authorization from the Engineer.

- B. Full load standby generator testing shall be conducted and satisfactorily completed prior to the performance of startup testing.

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Submit the following to the Engineer for review a minimum of two (2) weeks prior to commencement of startup:

1. Written certification by a representative of the manufacturer that each piece of equipment has been installed properly and is ready for operation.
2. Written certification by a representative of the equipment manufacturer that all equipment requiring calibration has been properly calibrated.
3. Written certification by a representative of the instrumentation control and telemetering system manufacturer that all systems are fully functional and operational.
4. A schedule of the testing, including staffing, and specific testing and operation of individual equipment items.
5. Submit a copy of the attached forms indicating that all required equipment is installed and has been operated and tested by the Contractor and the manufacturer's representative(s).
6. Generator Load Bank test results with sound monitoring data per Section 16 - Electrical.

- B. At the conclusion of the acceptance test, all information recorded during the test shall be forwarded to the Engineer in accordance with Section 01 33 23 SUBMITTALS.

PART 2 – PRODUCTS

NOT APPLICABLE

PART 3 – EXECUTION

3.01 PREPARATION:

- A. Prior to commencement of testing, the Engineer shall be given fourteen (14) days' written notice.
- B. The Contractor shall complete final debugging prior to startup.

- C. All telemetry equipment shall be operational prior to testing.
- D. The testing shall be performed.
- E. Part of the testing shall be accomplished on standby power.

3.02 TEST PROCEDURES:

- A. It is the responsibility of the Contractor to insure that all equipment is completely operational throughout the test; provide the Engineer with proper technical assistance as required to completely test all equipment and alarms; provide adequately trained personnel who can operate the pump station on an on/off basis so that the equipment is not damaged, whether the Engineer or Owner is present or not during that portion of the test.
- B. The Engineer shall during the test period direct the Contractor's supervision of the testing of all equipment, associated alarms and devices; to vary the operation of the equipment as necessary, and to pump as required.
- C. The Contractor shall provide a sufficient supply of water, at no additional cost to the Owner, to allow the pumps to operate during the entire test, so that the full range of pump operation is tested under varying incoming flows.

The minimum duration of the testing shall be as shown below:

Pump Stations -

Packaged suction lift – 4 hours

Testing will be performed as long as is required for the Engineer to be satisfied that all equipment functions properly under expected conditions of service.

- D. The Contractor shall be backcharged for all Contractor-requested visits made to the site by the Engineer for the purpose of startup and testing when the Engineer determines that testing may not proceed due to unavailability of needed Contractor/subcontractor/vendor personnel at the site or the Contractor's failure to have any equipment properly functional at the time of the Engineer's visit.

3.03 STOPPING OF TEST:

- A. The Engineer shall stop the testing for any of the following reasons:
 - 1. Failure of critical system, including:
 - a. Pumps and Motors
 - b. Telemetry Equipment
 - c. Instrumentation

d. Standby Engine System

2. Failure of any of the above systems to operate on standby power.

B. If the test is stopped for any reason, the test shall be restarted from the beginning. The Contractor shall pay all costs associated with the Owner and Engineer supervising additional testing as required.

3.04 EXPENDABLES:

A. Unless otherwise indicated, the General Contractor shall be responsible for providing all fuel during construction and providing a full tank of fuel oil if applicable at no additional cost to the Owner, at beneficial occupancy.

END OF SECTION

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START-UP REPORT

DATE/TIME: _____

INSPECTOR(S): _____

JOB NAME: _____

STATION NAME: _____

LOCATION: _____ ENGINEER: _____

CONTRACTOR: _____

SUB-CONTRACTOR(s): _____

PEOPLE PRESENT AT THE START-UP:

_____	_____
_____	_____
_____	_____
_____	_____

DESCRIBE STATION LAYOUT: _____

LIQUID BEING PUMPED: _____

COMMENTS: _____

Prepared By: _____
Contractor:

Date: _____

Startup Witnessed by: _____
Weston & Sampson Engineers, Inc.

Date: _____

MOTOR No. _____

MANUFACTURER: _____

MODEL NUMBER: _____ SERIAL NUMBER: _____

VOLTAGE: _____ PHASE: _____ AMPS: _____

HORSEPOWER: _____ HERTZ: _____

CONDITION OF CABLE JACKET: GOOD: _____ FAIR: _____ POOR: _____

GROUND RESISTANCE? _____

SUPPLY VOLTAGE: L1:L2 _____ L2:L3 _____ L3:L1 _____

AMPERAGE PUMP MOTOR: (BLACK) L1: _____ (RED)L2: _____ (WHITE)L3: _____

PUMP # _____

MANUFACTURER: _____

MODEL NUMBER: _____ SERIAL NUMBER: _____

GPM: _____ TDH: _____ SIZE: _____

GAUGE READINGS: SUCTION PRESSURE (ft/psi): _____

DISCHARGE PRESSURE (ft/psi): _____

RUNNING TIME METER (hours): _____

CONDITION OF EQUIPMENT: GOOD _____ FAIR: _____ POOR: _____

FLOW TEST: START LEVEL: _____ FINISH LEVEL: _____

TIME SPAN: _____ GALLONS/INCH: _____

GALLONS/MIN: _____ PRESSURE: _____

SHUT-OFF PSI: _____ DISCHARGE LINE FULL? _____

VIBRATION

MOTOR: UPPER BEARING: _____ (inches/sec)

LOWER BEARING: _____ (inches/sec)

PUMP: UPPER BEARING: _____ (inches/sec)

LOWER BEARING: _____ (inches/sec)

Prepared by Contractor's Representative: _____ Date: _____

PUMP CONTROL PANEL

MANUFACTURER: _____

MODEL NUMBER: _____ SERIAL NUMBER: _____

TYPE: _____ AMP RATING: _____

OVERLOAD TYPE: _____

SIZE: _____ AMP RATING: _____

DO PROTECTIVE DEVICES COMPLY WITH PUMP MOTOR AMP RATING? _____

MOTOR STARTERS/VFD: _____

ARE WIRES LABELED (TAGGED)? _____

ALARMS:

HIGH WATER: _____ PUMP FAIL: _____

LOWWATER: _____ MOISTURE: _____

TEMPERATURE: _____ OTHER: _____

TYPE: _____

Prepared by Contractor's Representative: _____ Date: _____

MOTOR CONTROL CENTER (MCC) (IF APPLICABLE)

MANUFACTURER: _____ SERIAL NUMBER: _____

MAIN: _____

DESCRIBE LAYOUT: _____

DRAWING LAYOUT OF MCC:

Prepared by Contractor's Representative: _____ Date: _____

LIQUID LEVEL CONTROLS

MANUFACTURER: _____

MODEL NUMBER: _____ SERIAL NUMBER: _____

FLOAT SWITCHES: _____

IF FLOATS, DESCRIBE OPERATION: _____

IF BUBBLER SYSTEM, DESCRIBE OPERATION: _____

LEVEL CONTROL COMPRESSOR:

MANUFACTURER: _____

MODEL: _____ SERIAL NUMBER: _____

TANK: _____

DRAIN: _____

COMMENTS: _____

Prepared by Contractor's Representative: _____ Date: _____

STAND-BY GENERATOR (IF APPLICABLE)

ENGINE

MANUFACTURER: _____

MODEL: _____ SERIAL NUMBER: _____

GENERATOR

MANUFACTURER: _____

MODEL: _____ SERIAL NUMBER: _____ RATING: _____

AUTOMATIC TRANSFER SWITCH

MANUFACTURER: _____

MODEL: _____ SERIAL NUMBER: _____

CHECK THE FOLLOWING WHEN RUNNING (be sure to note units):

RPM: _____
VOLTS(AC): _____ (VOLTS)
AMPS (AC): _____ (AMPS)
FREQUENCY: _____ (HERTZ)
OIL TEMP: _____ (DEGREES
OIL PRESSURE: _____
WATER TEMP: _____ (DEGREES
RUN TIME: _____ (HOURS)

LEAKS OR UNUSUAL ACTIVITY? EXPLAIN: _____

COMMENTS: _____

Prepared by Contractor's Representative: _____ Date: _____

MISCELLANEOUS EQUIPMENT

FLOW METER

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

HEATER

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

VENTILATION SYSTEM

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

DEHUMIDIFIER

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

SUMP PUMP

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: GPM: _____ TDH: _____
 HP: _____ AMP: _____ VOLT: _____

OTHER

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

COMMENTS: _____

Prepared by Contractor's Representative: _____ Date: _____

SECTION 01 75 13

EQUIPMENT CHECKOUT AND TESTING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. The physical checkout and testing requirements in this Section are in addition to those requirements defined in the technical specifications.

1.02 RELATED WORK:

- A. Section 01 75 00 STARTUP AND TESTING FOR SEWER PUMP STATIONS
- B. Division 11 through Division 40.

1.03 DEFINITIONS:

- A. Shop Testing is defined as testing that is performed by the manufacturer either at the place of manufacture, or the place of assembly, for the purpose of proving that the equipment meets the requirements of the technical specification(s).
- B. Physical Checkout is defined as the process whereby the Contractor physically inspects products after they have been installed in the work, and certifies that the products have been properly and completely installed, and are ready for field testing.
- C. Field Testing is defined as testing that is performed on products by the Contractor with the assistance of the manufacturer's representative, after the performance of physical checkout, for the purpose of proving that the tested products meet the specifications. While field testing can be described as "shop testing in the field", it may be required whether or not shop testing was performed on the product.
- D. System Testing is defined as testing performed on a "system" normally comprised of two or more pieces of equipment, after physical checkout and field testing have been completed, for the purpose of proving that the system meets specifications. System testing is described in Section 01 75 00, STARTUP AND TESTING FOR SEWER PUMP STATIONS.
- E. Manufacturer's representative, sometimes referred to as the Factory-Trained Service Technician, is defined as a person provided by the manufacturer, who is qualified by training and experience to provide technical and process related advice, and/or assistance, relating to the installation or utilization of the products provided by the manufacturer. Minimum training and experience shall include not less than three years participation in similar work, including no less than three similar projects during this three-year period.

1.04 SHOP TESTING:

- A. When required by the specifications, shop testing shall be performed prior to delivery of the equipment or material. If shop testing is not required by the technical specifications, provide shop testing as detailed in Paragraph 1.06. Provide a minimum of fifteen days written notice, indicating the time and place of testing. Submit the following to the Engineer for approval not less than fifteen days prior to this notice.
1. Description of the test - Outline how the tests will conform to the requirements of the specifications.
 2. Testing devices that will be used in the tests - description must state how the devices will perform or what they will measure, and the device accuracy. Submit sample measurement results and catalog cuts.
 3. Schedule for testing - schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or test failure.
 4. Test forms - submit samples of all forms used to record and report on shop test data. Forms shall include description of test, test date, equipment used, equipment tested, personnel present, equipment tag ID numbers, and measurements made. Forms shall have a place for signature by the chief testing person, and an officer of the manufacturer certifying that the tests results shown are true, accurate, have met the required criteria, and that the equipment will operate as indicated.
- B. Submit the following to the Engineer within one week after completion of the tests.
1. Completed test forms for each device tested.
 2. Completed certification.
 3. A written summary of testing, reporting results.
 4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the specification test requirements at no additional cost to the Owner. Additional travel required by the Engineer and the Owner personnel to witness retesting shall be paid by the Contractor, at no additional cost to the Owner.

1.05 PHYSICAL CHECKOUT:

- A. Physical checkout shall include the following, where applicable:
1. Verify exterior areas for backfill, grading, surfacing, drainage, landscaping, roadways, fencing, and gates.
 2. Verify buildings for structure, masonry, architectural, mechanical systems,

electrical/lighting, communications, and HVAC.

3. Verify concrete structures for structural integrity, finish tolerance, durability, appearance, embedded and inserted items, painting and surface applications.
4. Verify steel structures for member alignment, connection bolts torque, connection welds integrity, painting, fire proofing and surface applications.
5. Verify mechanical systems and items for setting, alignment and securing, check and adjust packing and seals, lubrication, drying out, drive connection and alignment including rotation and belt/chain tension, painting or surface applications, and tagging for project system.
6. Verify piping systems for material, size, components, direction, alignment of joints and bolts/welding, packing and seals, screens and filters and strainers, leak and pressure hydro tests, painting and color coding, hangers and anchors and expansion provision and supports, clean out of foreign matter and tagging for project system.
7. Verify electrical and control/instrumentation systems for conduit and tray installation, wire/cable material and size, circuit continuity and identification, voltage testing, ground continuity and testing, terminal installation and identification, jar switches and circuit breakers and transformers tested, substation operation tested, and tagging for project system.
8. Verify communication system including telephone, fire/smoke alarm, security, paging, closed circuit TV similar to electrical above.
9. Verify computer systems by station, function, network interface.
10. Each piece of equipment and system must be certified by the manufacturer's representative as described in subsection 1.07.

1.06 MINIMUM SHOP AND FIELD TESTING REQUIREMENTS:

If the technical specifications do not define shop and field testing requirements, the following requirements shall be acceptable.

- A. Measurement of wearing ring clearances for all pumps requiring assembly, so equipped:
 1. Take a minimum of two readings, 90 degrees apart.
 2. All measured clearances shall be within supplier's specifications for new Installations. Replace and recheck rings found to be out-of-round or out-of-specified tolerance.
- B. Measurement of impeller bore for all pumps requiring assembly:

1. Take a minimum of two readings, 90 degrees apart.
2. All measured clearances shall be within supplier's specifications for new installations. Replace and recheck impellers found to be out of round or out of specified tolerance.

C. Measurement of shaft run out for all rotating equipment requiring assembly:

1. Remove bearings from the shaft. Support shaft on pedestal rollers or in a lathe.
2. Check each shoulder on the shaft.
3. Take a minimum of two readings for each shoulder, 90 degrees apart.
4. All measured clearances shall be within supplier's specifications for new installations. Replace and recheck shafts found to be out of round or out of specified tolerance.

D. Vibration Measurements

1. Provide vibrational signature testing and documentation for each piece of direct drive, belt drive or close coupled rotating equipment with a motor HP of 5.0 or above and a rated operating speed in excess of 999 RPM.
2. Unless specified otherwise, the current edition of the Hydraulic Institute Standard, "Acceptable Field Vibration Limits" shall be the standard for vibrational testing.
3. Take all specified vibrational readings in three directions; vertical, horizontal, and axial.
4. Provide vibrational measurements in the following engineering units:
 - a. Displacement in thousandths of an inch (mils), peak to peak.
 - b. Velocity in inches per second (ips), peak to peak.
 - c. Acceleration in feet per second, zero to peak.
 - d. Spike energy in g-SE.
5. The vibrational reading shall be less than the allowable maximum for the device rotating frequency and within the operating band specified by the supplier.
6. Amplitude Allowable Maximums:

RPM

Amplitude Inches Peak to Peak

3,000 and above	0.001
1,500 - 2,999	0.002
1,000 - 1,499	0.0025
999 and below	0.003

- Utilize a Bently Nevada Dual Path Monitor, or equal for all vibrational measurements.

E. Belt Drives

All belts shall be in accordance with supplier's recommendations.

F. Gear Drives and Reducers

- Check gears for lash at no less than three points around the gear.
- Rotate a full 360 degrees while checking alignment.

G. Coupling/Shaft Alignment

- Perform all final alignments and checks with a dial indicator or a laser device. Feeler gauges and straight edges are not acceptable.
- Eliminate soft foot conditions prior to aligning.
- When checking for final soft foot any displacement readings in excess of 0.002-in. must be corrected.
- When checking for pipe strain, any displacement in excess of 0.002-in. requires piping realignment.
- Alignments will not be regarded as final until the grout is set and all piping has been attached. Demonstrate that alignment is not changed by attachment of piping.
- Shim the driving element; never the driven element.
- Take bracket sag corrections into account when using a dial indicator. Bracket sag shall be determined on rigid pipe.
- Mount a dial indicator to the driven element so that it can be rotated. Rotate both elements while aligning.
- When aligning three coupled elements, align gear reduction elements with the driven element first, then align the driver to the gear reduction elements.
- Check all four alignments: i.e. angular alignment in the vertical and horizontal planes, and parallel alignment in vertical and horizontal planes.

11. The minimum acceptable alignment accuracy for flexible couplings is +/- 0.005-in., or the supplier's specifications, whichever is more stringent.
12. The dial indicator must be perpendicular to the alignment surface.
13. Number hold down nuts prior to tightening. Loosen in reverse order. Tighten in ascending order.
14. Use only clean, deburred shims. Clean the machine base and remove rust or burrs prior to alignment.

H. Measurement of Noise (dB)

1. Eliminate noise sources generated by adjacent construction activity prior to testing.
2. Establish a background noise level prior to testing.
3. Perform noise level testing on each installation device as required by the technical specifications.
4. The maximum acceptable noise level exposure is 85 dBA over eight hours continuous for office, shop, and other areas where the Owner's personnel will be performing their assigned duties.

I. Hydrostatic Testing

1. AWWA C600 standards are the minimum acceptable standards for all hydrostatic testing.
2. Visually inspect all welds prior to testing, for cracks, undercut on surfaces greater than 1/32-in deep, lack of fusion on surface, reinforcement greater than Table 127.2.2 located in ANSI B31.1, Power Piping, and incomplete penetration (when accessible). Repair or rework as required by the Engineer.
3. At no time during hydrostatic testing shall any part of the piping system be subjected to a stress greater than 90% of its yield strength at test temperature.
4. After at least 10 minutes of full hydrostatic test procedures, make an examination for leakage of all joints, connections, and all regions of high stress, such as around openings and thickness transition sections.
5. Unless otherwise specified, the minimum required hydrostatic test pressure shall be 1.5 times the design pressure as specified and as indicated.
6. Unless otherwise specified, the minimum pressure holding time shall be 10 minutes plus the time required to inspect for leakage.

7. Maximum pressure shall not exceed the maximum rated pressure for any component in the system being tested.

J. Electrical Equipment

1. The testing standards for electrical components are those contained in Division 16 and in the pertinent technical specification(s).

1.07 SERVICES OF THE MANUFACTURER'S REPRESENTATIVE:

- A. Services of manufacturer's representatives shall be provided for equipment and systems specified in Divisions 11 through 40.
- B. Contractor shall coordinate services of the various representatives to avoid overlap, thereby ensuring all work may be observed by the Engineer, and the Owner's operating personnel may receive all required training.
- C. Contractor shall notify the Engineer in writing not less than ten working days prior to the visit of each manufacturer's representative.
- D. Manufacturer's representative shall provide services specified in Divisions 11 through 46. As a minimum, the services shall include the following:
 1. When each piece of equipment or system has been installed, including connection of permanent power and control, the equipment or system shall be started up and fully inspected, aligned and adjusted, including provision of lubrication and all pre-operative maintenance.
 2. Each piece of equipment or system shall be complete in all respects. Omission of any required items shall be corrected. Lack of discussion in the specifications of components which are necessary to equipment operation will not be accepted as the basis for an extra charge.
 3. At the time of the inspection the representative shall provide a minimum of two additional hours to train the Owner's operations personnel in the operation and maintenance of the equipment or system.
 4. Upon completion of this work the manufacturer's representative shall forward a copy of the report of his inspection to the Engineer via the Contractor. The report shall be on a form suitable to the Engineer and shall detail the work completed, deficiencies noted and/or corrected, any special instructions, and the names of Owner's personnel who received training. It shall also certify that the installation of the equipment or system is complete, ready for permanent operation, and free from any defects that would void the warranty.

5. Satisfactory certification of all individual equipment and systems must be received by the Engineer prior to the authorization to proceed with the overall start-up operation.
6. The manufacturer's representative shall return at a later date to supervise field tests, assist in start-up and perform any additional training required. Reports of these visits, specifically detailing the results of all field tests, shall be forwarded to the Engineer within 7 days of completion of the services.

1.08 CORRECTIONS TO THE WORK:

Correct any items of work failing to meet the specifications at no additional cost to the Owner. Correct the nonconforming items by re-work, modification, or replacement, at the option of the Engineer. Provide all required labor, materials, and retesting as specified herein, to verify that the equipment or system conforms to the specifications.

1.09 SAFETY:

Conduct all test procedures in compliance with all applicable safety standards and regulations.

END OF SECTION

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SECTION 01 78 00

PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers administrative and procedural requirements for closing out the project, including, but not limited to:
 - 1. Project as-built documents
 - 2. Checkout and Certification
 - 3. Startup and Testing
 - 4. Final Cleaning
 - 5. Substantial Completion
 - 6. Closeout Procedures
 - 7. Final Completion
 - 8. Correction/Warranty Period
- B. Closeout checklist to be completed by the Engineer.

1.02 RELATED WORK:

- A. General Requirements in their entirety.
- B. Section 01 74 13, CLEANING UP
- C. Section 01 75 00, STARTUP AND TESTING
- D. Section 01 75 13, EQUIPMENT CHECKOUT AND TESTING
- E. Section 01 78 39, PROJECT AS-BUILT RECORD DRAWINGS
- F. Division 2 through Division 40.

1.03 AS-BUILT DOCUMENTS:

- A. Contractor shall maintain on site, separate from the documents used for construction, one set of the documents listed below, and as construction progresses, shall legibly record on these documents all changes made during construction.
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other Modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Written interpretations and clarifications.
 - 7. Field Orders.
 - 8. Field test reports properly verified.
- B. The draft and completed set of as-built documents shall be submitted to the Engineer and Owner in conformance with the requirements of Section 01765.

1.04 CHECKOUT AND CERTIFICATIONS:

- A. Prior to checkout and certifications the following tasks shall be completed:
 - 1. Construction shall be complete. For this purpose, completion of construction is defined as follows:
 - a. The Contractor has completed construction and erection of the work in conformance with the Contract Drawings and Specifications.
 - b. The Contractor has installed and adjusted operating equipment, systems, or facilities, as applicable, as defined by the manufacturers' erection, installation, operation and maintenance instructions.
 - 2. All shop drawings shall have final approval.
 - 3. All shop tests shall be complete and approved test results submitted to the Engineer.
- B. Refer to Section 01 75 13 for requirements regarding equipment checkout and certification.

1.05 START-UP AND TESTING:

A. Prior to start-up the following tasks shall be complete:

1. All checkout and certifications shall be satisfactorily completed,
2. All operations and maintenance manuals shall be approved,
3. All preliminary training by the manufacturer's representative shall be completed,
4. An approved start-up procedure shall be in place.

B. Refer to Section 01 75 00 for start-up and testing requirements.

1.06 FINAL CLEANING:

A. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.

1. Clean the site, including landscape development areas of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to smooth, even textured surfaces.
2. Remove waste and surplus materials, rubbish, fencing equipment, temporary utilities and construction facilities from the site, unless otherwise required by the Engineer.
3. Comply with requirements of Section 01 74 13 CLEANING UP.

1.07 SUBSTANTIAL COMPLETION:

A. Substantial Completion is officially defined in the General and Supplementary Conditions. The date of substantial completion will be certified by the Engineer. This date will not be certified until the following requirements have been satisfied by the Contractor:

1. All Contract requirements are coordinated into a fully operational system. All individual units of equipment and treatment are fully operative and performing at specified efficiencies. Where efficiencies are not specified, performance shall meet acceptable standards for the particular unit.
2. All field tests have been satisfactorily completed and reports forwarded to the Engineer.
3. All final training has been completed by the manufacturers' representatives.

4. All spare parts and lubricants have been satisfactorily delivered to the Owner. Spare parts are for the exclusive use of the Owner when the facility has been turned over. Contractor is responsible for all maintenance and repair materials required until the facility is accepted by the Owner.

1.08 CLOSEOUT PROCEDURES:

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and is complete in accordance with Contract Documents and ready for Engineer's and Owner's inspection.
- B. Accompany Engineer and Owner on inspection to verify conformance with the Contract Documents. Prepare a punch list of work items that have been determined by inspection to not conform to Contract Documents. Punch list items shall include work items that are missing, incomplete, damaged, incorrect items, or improperly installed or constructed. The Contractor shall correct the punch list deficiencies by re-work, modifications, or replacement, as appropriate, until the items conform to the Contract Documents. The initial punch list shall be produced by the Contractor, with copies to the Engineer and Owner. When the Contractor has reduced the number of deficient items to a reasonable level, the Engineer will develop a definitive punch list for the use of the Contractor.
- C. Provide submittals to Engineer that are required by governing or other authorities.
- D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due. The Contractor shall submit the following documents with or prior to Final Application for Payment: Set of as-built documents, Contract Completion and Acceptance Certificate, Consent of Surety to Final Payment, Release and Waiver of Liens and Claims (SECTION 01 78 00 – ATT. A), Affidavit of Payment of Debts and Claims, and remaining releases, waivers, warranties/guarantees, and all other data required by the Contract Documents.

1.09 FINAL COMPLETION:

- A. Prior to final completion, the following tasks shall be completed:
 1. All items in the punch list shall be completed.
 2. All Contract closeout documentation shall be submitted to and accepted by the Engineer.

1.10 CORRECTION/WARRANTY PERIOD:

- A. During the correction period, the Contractor shall correct all deficiencies in equipment and materials.
- B. During the warranty period, the Contractor shall perform all corrective work on warranty deficiencies.

- C. Corrective work will be identified by the Engineer or Owner, as appropriate. The Contractor will be notified of the item(s) requiring corrective work.
- D. The Contractor shall begin work on all corrective work within ten days of being notified of the deficiency by the Engineer and shall then work continuously until the deficiency is corrected. Upon completion of the corrective work, the Contractor shall submit a letter report to the Engineer describing the deficiency and the corrective action that was taken.
- E. The Contractor shall coordinate all corrective work with the Engineer and/or the Owner.

1.11 COMPLETION CHECKLIST:

- A. The Project Completion Checklist, which follows, shall be modified as required for the specific project and shall be completed as the project nears completion. When the project has been fully completed, Final Payment can be approved.

PROJECT COMPLETION CHECKLIST

Owner _____ Job No.

Project _____

As part of the project closeout, all items listed below must be checked off as being complete or otherwise accounted for. The person verifying completion of the item shall list the completion date and his/her initials.

Project Closeout Checklist		
	Date Completion Verified	Verified by
AS-BUILT DOCUMENTS HANDED OVER		
1. Contract Drawings		
2. Specifications		
3. Addenda		
4. Change Orders/Contract Modifications		
5. Reviewed Shop Drawings, Product Data and Samples		
6. Written Interpretations/Clarifications		
7. Field Orders		
8. Field Test Reports		
EQUIPMENT CHECKOUT AND CERTIFICATIONS		
1. Construction Complete per Drawings/Specifications		
2. Equipment Installed and Adjusted		
3. All Shop Drawings have Final Approval		
4. All Shop Tests Complete and Results Submitted		

Project Closeout Checklist		
	Date Completion Verified	Verified By
START-UP AND TESTING		
1. All Checkout and Certifications Complete		
2. All O&M Manuals Approved		
3. All Preliminary Training by Manufacturers Rep. Completed		
FINAL CLEANING		
1. All Construction Facilities Removed		
2. All Construction Debris Removed		
3. All Areas Swept/Cleared		
SUBSTANTIAL COMPLETION		
1. All Items Coordinated Into a Fully Operational System		
2. All Equipment Units Operational at Specified Efficiencies		
3. All Field Tests Completed and Reports Submitted		
4. All Final Training by Manufacturer's Rep. Completed		
5. All Spare Parts and Lubricants Provided		
CLOSEOUT PROCEDURES		
1. Written Certification Submitted that Work is Ready for Owner & Engineer Inspector		
2. Inspection by Owner, Engineer, Contractor completed		
3. Punch List of Nonconforming Items Prepared		
4. Documents Required by Governing or Other Authorities Submitted (List Them)		
5. Final Application for Payment Received		
6. Contract Completion and Acceptance Certificate Submittal		
7. Consent of Surety to Final Payment Submittal		
8. Release and Waiver of Liens and Claims Submitted		
9. Affidavit of Payment of Debts and Claims Submitted		

Project Closeout Checklist

	Date Completion Verified	Verified By				
10. Warranties/Guarantees Submitted						
11. Other Required Releases and Waivers Submitted (List Them)						
12. Permits Submitted (List Them)						
13. Weekly Payrolls Submitted as Required by Law						
FINAL COMPLETION						
1. All Items in Punch List Completed						
2. All Other Required Documentation Submitted (List It)						
CORRECTION/WARRANTY PERIOD						
1. Correction Period Start Date: _____ End Date: _____						
2. Specific Warranties Provided						
<table border="0" style="width: 100%;"> <tr> <td style="text-align: center;"><u>Item</u></td> <td style="text-align: center;"><u>Warranty Duration</u></td> </tr> <tr> <td style="height: 150px;"></td> <td></td> </tr> </table>	<u>Item</u>	<u>Warranty Duration</u>				
<u>Item</u>	<u>Warranty Duration</u>					

Full name of persons signing their initials on this checklist:

END OF SECTION

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SECTION 01 78 39

PROJECT AS-BUILT RECORD DRAWINGS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the Contractors As-Built Record drawings for the project. The As-Built Record drawings for the project shall include, but are not limited to:

A. The Contractors construction coordination drawings for all the project disciplines. The Contractors construction coordination drawings for the project disciplines shall be submitted to the Engineer prior to Construction of the said discipline. The Contractors construction coordination drawings for the project disciplines shall include but are not limited to the following:

1. Architectural
2. Civil
3. Structural
4. Electrical
5. Mechanical
6. Plumbing
7. Process
8. Instrumentation

B. Draft Record Documents Review

Upon completion of the project construction the Contractor shall submit a complete copy of 24- by 36-inch Record Drawings to the Owner and the Engineer for review. The Owner and the Engineer shall jointly review the Record Drawings and provide comments to the Contractor. The Contractor shall modify the Record Drawings as necessary based on the comments provided by the Owner and the Engineer.

C. Final Record Documents

Upon incorporation and acceptance of the Draft Record Drawings comments from the Owner and the Engineer, the Contractor shall submit the Final Record Drawings and documentation. The Contractor shall submit two sets of 24- by 36-inch Record Drawings to the Owner and an additional two sets of 24- by 36-inch Record Drawings to the Engineer for their records. The Contractor shall also submit to the Engineer a minimum 20 gigabyte flash drive with the electronic Record Drawing files. The electronic Record Drawing files shall be obtained from the Owner (the Engineer shall provide on behalf of the Owner if the Engineer was the project designer) and developed in AutoCAD 2010/Revit 2017 (or later) and the submittal shall include the Final AutoCAD DWG/Revit RVT file documents, drawing line

types, blocks, etc. The actual version of AutoCAD/Revit shall be coordinated with the Engineer.

1.02 RELATED WORK:

- A. General Requirements in their entirety.
- B. Division 02 through Division 40.

1.03 AS-BUILT DOCUMENTS:

- A. Contractor shall maintain on site, separate from the documents used for construction, one complete set of the documents listed below, and as construction progresses, shall legibly record on these documents all changes made during construction.

- 1. Contract Drawings.
- 2. Specifications.
- 3. Addenda.
- 4. Change Orders and other Modifications to the Contract.
- 5. Reviewed shop drawings, product data, and samples.
- 6. Written interpretations and clarifications.
- 7. Field Orders.
- 8. Field test reports properly verified.

- B. The completed set of documents shall include but are not limited to:

- 1. Significant deviations of any nature made during construction.
- 2. All changes to the proposed contract documents.
- 3. Auto-CAD Record Drawings of the Pump Station.

- C. The completed set of as-built documents shall be submitted to the Engineer with the final Application for Payment.

PART 2 - MATERIALS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 92 13

OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 SCOPE OF WORK:

- A. This section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

1.02 RELATED WORK:

- A. General Requirements in their entirety (Section C-1.1 GENERAL CONDITION)
- B. Individual Technical Specification Sections Specific for Operation and Maintenance Data.
- C. Section 01 33 23.13, SUBMITTALS FOR OPERATION AND MAINTENANCE MANUALS
- D. Section 01 33 23, SUBMITTALS

1.03 FORMAT:

- A. Prepare data in form of an instructional manual.
- B. Binders: Commercial quality, 8 ½- x 11-inch three-ring binders with hardback, washable, plastic covers; two inch maximum ring size. When multiple binders are used, correlate data into related, consistent groupings. Provide a table of contents in each binder.
- C. Cover: Identify each binder cover and spine with typed or printed title OPERATION AND MAINTENANCE INSTRUCTION; list title of Project facility; identify subject matter of contents.
- D. Arrange contents by systems under section numbers and sequence of Table of Contents.
- E. Provide tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data - on 20-pound paper.
- G. Drawings: Provide with reinforced punched, binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Submit certification that the data and drawings provided pertain exactly to the model, size, and series product and equipment installed in the work.
- I. All documents will be electronically scannable.

J. All products, systems, and drawings must be cross-referenced with tag ID numbers.

K. The manual for each piece of equipment shall be a separate document with the following specific requirement:

1. Contents:

Table of Contents and Index

Brief description of each system and components

Starting and stopping procedures

Special operating instructions

Routine maintenance procedures

Manufacturer's printed operating and maintenance instructions, parts list, illustrations, and diagrams

One copy of each wiring diagram

One copy of each approved shop drawing and each Contractor's coordination and layout drawing

List of spare parts, manufacturer's price, and recommended quantity

Name, address and telephone number of local service representatives.

2. Material

Loose leaf on 60 pound, punched paper

Holes reinforced with plastic cloth or metal

Page size, 8 1/2- x 11-inches

Diagrams, illustrations and attached foldouts as required, of original quality, reproduced by dry copy method

Covers: oil, moisture and wear resistant 9 x 12 size

1.04 QUALITY ASSURANCE:

- A. Prepare instructions and data by personnel experienced in maintenance and operations of described products.

1.05 CONTENTS, EACH VOLUME (BINDER):

- A. Table of Contents: Provide title of Contract, schedule of products and systems, indexed to content of the volume. A listing of all relevant tag ID numbers for each volume shall be placed immediately after the Table of Contents.
- B. For each product or systems: List names, addresses, and telephone numbers of subcontractors and suppliers, including local source of suppliers and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- E. Text: As required to supplement product data, provide logical sequence of instructions for each procedure incorporating manufacturer's instructions.
- F. Warranties, Guarantees, and Bonds: Bind copy of each
- G. See O&M Manual Review Checklist at end of this specification section.

1.06 MANUAL FOR MATERIALS AND FINISHES:

- A. Building Products, Applied Materials, and Finishes: Include product data with catalog number, size composition, and color and texture designations. Provide information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional Requirements: As specified in individual product specification sections.

1.07 MANUAL FOR EQUIPMENT AND SYSTEMS:

- A. Each Item of Equipment and Each System: Include description of unit or system and component parts. Identify function, normal operating characteristics and

limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

- B. Data submitted on all equipment shall include complete maintenance instructions (including preventive and corrective maintenance) and parts lists in sufficient detail to facilitate ordering replacements.
- C. All products, systems, equipment, electrical wiring, instrumentation wiring, personnel protection systems wiring, presented in this manual will have tag numbers corresponding to contract drawings and specifications. In the event, numbers do not exist; the Engineer will specify a series of numbers.
- D. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.
- E. Include color-coded wiring diagrams as installed.
- F. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequence. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter and any special operating instructions.
- G. Provide servicing and lubrication schedule, and list of lubricants required. Cross-reference lubricants to products offered by at least three major lubricant suppliers.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide Contractor's coordination drawings, with color-coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- O. Include test and balancing reports, calibration data, alignment records, and other information.
- P. Additional Requirements: as specified in individual product specification sections.

- Q. Provide a listing in table of Contents for design data with tabbed flysheet and space for insertion of data.
- R. Incorporation of all Physical Checkout information obtained through the field-testing and correction phases of the Work. Input must be specific to the actions and information obtained during those phases.

1.08 SUBMITTALS:

- A. Submit draft and final copies of operation and maintenance manuals as described in Section 01 33 23.13 SUBMITTAL OF OPERATION AND MAINTENANCE MANUALS.

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

Not used.

Note to Specifier: Review the attached Checklist and add items that are required or delete items not relative to this project.

**OPERATION AND MAINTENANCE MANUAL
REVIEW CHECKLIST**

1. Name, address, telephone/fax number of the manufacturer
2. Name, address, contact name, telephone/fax of local representative
3. Name, address, telephone/fax number of the contractor
4. Exploded view/general arrangement of materials of construction
5. Description of operation/operating principal
6. Project specific Operating parameters
7. Wiring Diagrams (If Applicable)
8. Troubleshooting checklist
9. Recommended spare parts list with prices, and ordering instructions
10. Model number and the serial number of the model provided
11. Performance curves or tabulated data
12. Routine Maintenance instructions/service instructions with recommended Intervals
13. Assembly and disassembly instructions
14. Recommended lubricates and lubrication schedule.
15. Approved copies of Shop Drawings are to be included in the manual
16. Startup/break-in and adjustment instructions
17. Warranty information

Reviewed By: _____
Weston & Sampson Engineers

Date: _____

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END OF SECTION

SECTION 02 41 13

SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.01 SCOPE OF WORK:

- A. Work under this Section shall consist of the careful removal, storage for reuse, transportation off-site, or demolition, of all structures and site features encountered or noted to be removed or abandoned, and the removal and disposal of all materials not called for to be reused or salvaged, in accordance with the contract drawings, these specifications, and Engineer's requirements. Provide all labor, equipment, materials and transportation necessary to complete the work.
- B. Items on plan referenced to be removed and stored shall be carefully removed and stored on site in a manner and location designated by the Engineer for reinstallation later as shown on the plans or as indicated by the Engineer.
- C. Items on plan referenced, or as indicated by the Engineer to be removed and disposed of shall be removed from the site and properly and legally disposed of by the Contractor.
- D. Items indicated on the contract drawings or in the specifications to be removed and salvaged, or other items required to be removed by the Engineer, shall be transported to a municipal storage facility, located within the City confines, and unloaded and stacked as required by the Engineer.
- E. Items indicated on the contract drawings or in the specification to be removed and reset shall be carefully removed and reset in the same location as existing according to the specification and details.
- F. The following scope describes the general work/demolition requirements of this Section.
 - 1. Bituminous concrete pavement
 - 2. Fencing, chain link gates, and footings complete
 - 3. Ductile iron gate valves
 - 4. Ductile iron pipe
 - 5. Pump station structures and all internal equipment
 - 6. Generator and electrical panel

7. Level control instruments
8. Other features as indicated on the drawings

1.02 RELATED WORK:

- A. Section 01 12 16, SCOPE AND SEQUENCING OF WORK
- B. Section 01 14 19.25, DUST CONTROL
- C. Section 02 41 19.16 MINOR ELECTRICAL DEMOLITION
- D. Section 31 00 00, EARTHWORK

1.03 PROTECTION:

- A. The Contractor shall assume complete responsibility and liability for the safety and structural integrity of all work and utilities to remain during demolition.
- B. Provide safeguards including, but not limited to, warning signs, barricades, temporary fences, warning lights and other items required for protection of personnel and the general public during performance of all work.
- C. All features related to protection shall be maintained until that work has been completed to the point when such safeguards are no longer required.

1.04 SPECIAL REQUIREMENTS:

- A. Install erosion controls to protect adjacent areas from eroded materials likely to enter wetlands, resource areas, or drainage ways/systems, downstream of areas disturbed by work activities.
- B. Where items to be demolished are located within or adjacent to pavements to remain, the Contractor shall make provisions to protect that pavement to remain. Cut concrete pavement back to score line and cut bituminous concrete pavement back far enough so as not to allow disturbance to base course materials. Pavements damaged as a result of Contractor activities shall be replaced to the extent determined by the Engineer at no additional cost to the Owner.

1.05 REGULATORY REQUIREMENTS:

- A. Conform to applicable codes and requirements for demolition of structure, safety of adjacent structure, dust control, service utilities, and discovered hazards.

- B. Dispose or recycle all demolition debris in accordance with all applicable regulations.

1.06 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. In accordance with Section 01 33 23, SUBMITTALS, submit a demolition plan to the Engineer for review at least two weeks prior to the start of work, describing the proposed sequence, methods, and equipment required for the demolition and disposal. Also, indicate measures to be taken to protect new work, and structures and facilities to remain.
- B. Do not proceed with the demolition until the Engineer has given written acceptance of the demolition plan. Also, no demolition work shall proceed until the new facility is complete, fully operational, and beneficial occupancy has been obtained by the Owner.

PART 2 - PRODUCTS

2.01 BACKFILL:

- A. The Contractor shall provide suitable backfill as specified under Section 31 05 13.22 of these Specifications, to fill voids left by removal or abandonment of site features, and shall provide all pipe cap ends, mortar, brick and other material needed to cap off or plug pipes of various sizes and kinds.
- B. Suitable materials shall be used as base course fill and topsoil to the depth as specified herein. Restore disturbed areas with similar materials blended to match the line and grades of adjacent surfaces.

2.02 TEMPORARY FENCE:

- A. The work shall include temporary installation of chain link fence around the perimeter of the work limits where shown on the plans, and as required by the Engineer, and as Contractor sees fit to protect work.
- B. Temporary fence shall consist of 6 foot high chain link fence anchored into a base that is both stable and movable to allow access and adjustment as needed. Reclaimed existing fence fabric and materials may be used with the approval of the Engineer. The Contractor shall submit a shop drawing to the Engineer for approval prior to installation.

PART 3 – EXECUTION

3.01 PREPARATION:

- A. Provide, erect, and maintain temporary barriers and security devices.
- B. Notify Owner of procedures which may affect property, of potential noise, utility outage, or disruption. Coordinate with Owner.
- C. Erect and maintain temporary partitions to prevent spread of dust, odors and noise to permit continued Owner occupancy.
- D. Protect existing items which are not indicated to be removed.
- E. Arrange with, pay for all required fees, and perform work required by utility companies and municipal departments for discontinuance or interruptions of utility services due to demolition work.

3.02 DEMOLITION REQUIREMENTS:

- A. Conduct demolition in accordance with approved plan, so as to minimize interference with adjacent building areas.
- B. Under no circumstances shall explosives be used.
- C. Conduct operations with minimum interference to public or private accesses.
- D. Maintain protected access and egress at all times. Do not close or obstruct roadways without permits.
- E. Cease operations immediately if adjacent structure appears to be in danger. Notify Engineer.

3.03 PUMP STATION DEMOLITION:

- A. Disconnect, cap, identify and remove designated utilities.
- B. Demolish components indicated, in an orderly and careful manner.
- C. Demolish all internal equipment.
- D. Remove foundations and substructure.
- E. Backfill excavations in accordance with Section 31 00 00, EARTHWORK.

- G. Rough grade and compact areas affected by demolition to maintain grades and contours per Drawings.

3.04 SELECTIVE DEMOLITION:

- A. Demolish and remove components in an orderly and careful manner, in sequence as indicated on Drawings.
- B. Protect existing supporting structural members and equipment.

3.05 CLEAN UP:

- A. Remove demolished materials from site as work progresses.
- B. Leave areas of work in clean condition.

3.06 SCHEDULE OF PRODUCTS TO BE REMOVED:

- A. Remove, store, and protect the following materials and equipment:
 - 1. EOS alarm system. Contractor may choose to use system for bypass pumping alarming. System components shall be returned to the Owner if not used by the contractor, or after bypass pumping is complete.

END OF SECTION

SECTION 02 41 19.16

MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of existing electrical service wiring.
 - 2. Disposal of materials.
 - 3. Storage of removed materials.
 - 4. Identification of utilities.
- B. Related Sections:
 - 1. Section 02 41 19 – SELECTIVE STRUCTURE DEMOLITION.
 - 2. Section 26 20 00.13 – ELECTRICAL WORK GENERAL PROVISION.

1.2 CLOSEOUT SUBMITTALS

- A. Section 01 78 00 – Project Closeout: Requirements for submittals.
- B. Project Record Documents: Record actual locations of capped utilities conduits and equipment abandoned in place.

1.3 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.4 SCHEDULING

- A. Schedule work to coincide with new construction.
- B. Cease operations immediately when structure appears to be in danger and notify Engineer. Do not resume operations until directed.

1.5 COORDINATION

- A. Conduct demolition to minimize interference with adjacent building areas.
- B. Coordinate and sequence demolition so as not to cause shutdown of operation of existing processes or surrounding areas.
- C. Identify salvage items in cooperation with Owner.

PART 2 PRODUCTS
Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- B. Verify termination points for demolished services.

3.2 PREPARATION

- A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.

3.3 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- B. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring, which are not part of final project.
- C. Perform work on energized equipment or circuits with experienced and trained personnel.
- D. Cap abandoned empty conduit at both ends.

3.4 CLEANING

- A. Remove demolished materials as work progresses. Legally dispose.
- B. Keep workplace neat.

END OF SECTION

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SECTION 03 01 30.62

REPAIR OF EXISTING CONCRETE STRUCTURES

PART 1 GENERAL

1.01 WORK INCLUDED:

Furnish all labor, materials, equipment and incidentals required to repair deteriorated areas of existing concrete wetwell structures including the sealing of existing joints as required by the Engineer in the field and as specified herein.

1.02 RELATED WORK:

- A. Section 01 33 23, SUBMITTALS
- B. Division 03, CONCRETE
- C. Section 09 96 56, PROTECTIVE COATING
- D. Division 31, EARTHWORK

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING

- A. Prior to shipment, and in accordance with Section 01 33 23, the Contractor shall submit to the Engineer for review, the following: manufacturer's technical literature for epoxy bonding agent, adhesive anchor system, repair mortar, and polyurethane chemical grout. The Contractor shall include manufacturer's installation and or application instructions in the submittal.
- B. A complete, easily readable functional description of the proposed product.
- C. Upon completion of installation, the results of the field and acceptance tests as specified under this section of the specification shall be submitted to the Engineer.
- D. Furnish written certification from the manufacturer's representative of the proper installation and use of each product.

1.04 REPAIR CLASSIFICATIONS:

- A. Polyurethane Chemical Grout Crack Repair

Cracks that are wet or are actively leaking shall receive polyurethane chemical grout treatment.

B. Epoxy Injection Crack Repair

Dry cracks to be injected with epoxy resin shall be between 0.005 inch and 0.25 inch in width.

C. Partial Depth Concrete Repair – Less Than 2”

Concrete repairs less than or equal to 2” in depth shall be repaired with epoxy mortar.

D. Partial Depth Concrete Repair – More Than 2”

Concrete repairs greater than 2” in depth shall be repaired with concrete.

E. Concrete Skim Coating Repair

All interior concrete surfaces of wetwell, including walls, bottom of top slab, and floor (after slope modifications) shall receive mortar clad scratch coat before protective coating is applied.

F. Concrete Protective Coating

Wetwell interior walls, floor (after floor modifications per drawings) and bottom of top slab shall receive a multi-layer protective coating applied to the limits shown on the Drawings.

1.05 REFERENCES:

- A. The following standards form a part of this specification and indicate the minimum standards required:

American Society for Testing and Materials (ASTM)

ASTM C881 -Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

ASTM C882 -Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE:

- A. Do not begin repair work until authorized by the Engineer to do so.

- B. When removing deteriorated concrete erect barriers or other protective devices to prevent damage to the structures beyond the limits of new work, protect personnel, control dust and prevent damage by falling or flying debris.
- C. Unless otherwise indicated or specified, saw cut the limits of all concrete repairs.
- D. Furnish a notarized certificate stating that the materials to be provided meet the requirements of this Section and have the manufacturer's current printed literature on the specified product.

1.07 MANUFACTURER'S QUALIFICATIONS:

- A. Consideration shall be given only to well-established and reliable manufacturers who are regularly engaged in such work and thoroughly experienced in the design and manufacture of said systems. The manufacturer shall certify a minimum of ten (10) years of experience in the manufacture and use of the products specified under this section as evidence of meeting the experience requirement.
- B. The system described herein and shown on the drawings establishes a standard of required type, function and quality to be met by any proposed substitute or "or-equal" systems. All "or-equal" systems shall meet the exact system configuration and operational function as shown on the drawings and specified herein. No "or-equal" system shall be considered by the Engineer unless written request for approval has been submitted for and approved by the Engineer in writing. The burden of proof of merit for the proposed "or-equal" systems is upon the Contractor and the proposed equipment manufacturer. The Engineer's decision of approval or disapproval of a proposed item shall be final. If the Engineer approves any "or-equal" item, the Contractor shall indemnify, hold harmless and defend both the Owner and the Engineer from any claims associated with the "or-equal" systems. Approval of "or-equal" systems does not relieve the Contractor of any requirements specified herein, called for by the Engineer or shown on the drawings.

1.08 DELIVERY, STORAGE AND HANDLING:

Deliver products in original, unopened containers clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions. Storage and condition of products shall be as recommended by the manufacturer.

1.09 WARRANTY:

- A. The manufacturer shall warranty, in writing, that the products supplied under this Section fully meet the criteria specified herein, and shall further warranty that the products are free from all defects in materials and workmanship.

- B. The manufacturer's warranties from defects shall contain a provision that the manufacturer shall repair or replace any defects, to the satisfaction of and at no additional cost to the Owner, for a period of twelve (12) months from the date of Substantial Completion.

PART 2 – Products

2.01 EPOXY INJECTION

- A. Surface Seal - Use the materials to seal the crack faces that have the strength and adhesion to contain the injection adhesive in the crack during the injection process and while the injection adhesive cures, and, if required to be removed, shall not leave a residue or damage the surfaces.
- B. Injection Adhesives
 - 1. Injection adhesives for cracks that can be sealed on all faces—Use an adhesive that conforms to the requirements of ASTM C 881/C 881M, Type IV, Grade 1. Product shall be Sikadur-35 Hi-Mod LV or approved equal.
 - 2. Injection adhesives for cracks that cannot be sealed on all faces—If all faces of the crack cannot be reached to apply a surface seal, use an injection adhesive that conforms to the requirements ASTM C 881/C 881M, Type IV, Grades 1, 2, or 3, and has a viscosity that will allow it to achieve and maintain the penetration required. Product shall be Sikadur-35 Hi-Mod LV or approved equal.

2.02 CONCRETE FOR PARTIAL DEPTH REPAIRS

- A. Concrete for partial depth repairs shall be either a prepackaged mix or ready-mix with a minimum 28-day compressive strength of 5,000 psi. The concrete shall use a maximum aggregate size of 3/8". The concrete shall also have an air entrainment of 6%, $\pm 1.5\%$.

2.03 CONCRETE SKIM COAT/PROTECTIVE COATING

- A. Base coat/skim coat shall be Tnemec Series 218/219 mortar clad or approved equal.
- B. Protective top coating shall be Tnemec Series 435 Perma-Glaze or approved equal.

2.04 POLYURETHANE CHEMICAL GROUT:

- A. General

1. The grouting compound shall be a single component, expanding, moisture reactive polyurethane grout that is designed to seal cracks and open joints in concrete. The cured chemical grout shall form a compressed closed cell urethane foam that shall completely fill the crack or joint.
2. An accelerator may be used if recommended by the approved polyurethane chemical grout manufacturer.
3. Injection packers shall be required for application of polyurethane chemical grout in existing concrete.

B. Properties of cured material

1. Tensile Strength (ASTM D 1623): 15.5 psi minimum at 1 day. Elongation at Break – 25 percent.
2. Shear Strength (ASTM C273): 11.70 psi minimum at 1 day.
3. Shrinkage (ASTM D2126): 0 percent
4. Water Absorption (ASTM D2842): 0.09 lb/square ft
5. Density (ASTM D1 622): 1.64 lb/cubic ft

C. Approved manufacturers include:

1. Sika Corporation, Lyndhurst, NJ – SicaFix HH-LV, or equal.

PART 3 – EXECUTION

3.01 GENERAL:

- A. Repair deteriorated areas of concrete and seal existing joints and cracks as required by the Engineer and as specified herein.
- B. All commercial products shall be stored, mixed and applied in strict compliance with the manufacturer's recommendations and as specified herein.
- C. Where concrete is repaired in the vicinity of an expansion joint or control joint, preserve the isolation between components on either side of the joint.

3.02 CONCRETE PREPARATION FOR REPAIR

Concrete to be repaired shall be prepared in accordance with the requirements of this paragraph and with the special requirements of this section.

A. Removal and Cleaning

All damaged, deteriorated, loosened, or unbonded portions of existing concrete shall first be removed by water blasting, bush hammering, jack hammering, or any other approved method, with approved equipment, after which the surfaces of existing concrete shall be prepared by contained shotblasting, wet sandblasting, or water blasting to remove any microfractured surfaces resulting from the initial removal process. The surfaces shall then be cleaned and allowed to dry thoroughly, unless the specific repair technique requires application of materials to a saturated surface. Concrete removal processes involving the use of jack hammers in excess of 30 pounds, dry sandblasting, or scrabblers shall not be used without approval by the Engineer. The use of acids for cleaning or preparing concrete surfaces for repair will not be permitted.

B. Saw Cut Edges

The perimeters of repairs to concrete that involve concrete removal and subsequent materials replacement shall be saw cut perpendicular to the repair surface to a minimum depth of 1 inch. Featheredge repairs to concrete shall not be used.

C. Reinforcing Steel

All loose scale, rust, corrosion by products, or concrete shall be removed from exposed reinforcing steel. Reinforcing steel exposed for more than one-third of its perimeter circumference shall be completely exposed to provide 1-inch minimum clearance between the steel and the concrete. Damaged or deteriorated reinforcing steel shall be removed and replaced as required by the Engineer.

D. Maintenance of Prepared Surfaces

After the concrete has been prepared and cleaned, it shall be kept in a clean, dry condition until the repair has been completed. Any contamination, including oil, solvent, dirt accumulation, or foreign material shall be removed by additional wet sandblasting and air-water jet cleanup followed by drying.

3.03 POLYURETHANE CHEMICAL GROUT:

- A. Apply polyurethane chemical grout to leaking cracks, joints, and voids in existing concrete.
- B. Clean concrete surfaces as required by the manufacturer of the polyurethane chemical grout.
- C. The polyurethane chemical grout shall be installed through drilled-in injection ports installed as recommended by the polyurethane chemical grout manufacturer. Installation and curing of polyurethane chemical grout shall be in accordance with manufacturer's requirements.

- D. Remove all excess material from the interior face of walls, floors, etc. and the exterior face of walls to the satisfaction of the Engineer.
- E. Remove all injection ports and seal with grout. The repair area shall be flush with the surrounding concrete surface.
- F. At completion of repairs, the Contractor, Engineer, and installers of the materials used on the repairs shall inspect the work. Any leaky joints, cracks, or voids shall be repaired in accordance with the manufacturer's instructions at no additional cost to the Owner. At the completion of the repairs, the Contractor, Engineer, and installers of the materials shall again inspect the repaired problem areas.

3.04 EPOXY INJECTION CRACK REPAIR

A. Evaluation

1. Crack Width – Inspect all cracks to determine if they are within the specified range stated in Section 1.04. When required, measure the width of the crack to make this determination, and make the measurement at the time of day when the cracks are at their widest as measured at the surface of the concrete member.
2. Crack Movement – If the width of a crack changes because of daily temperature cycles or other external loading of the structure, inject the crack when it is at its widest.

B. Preparation

1. Remove foreign material, such as dirt, oil, grease, or other chemicals, from the cracks before injection.
2. Water in cracks—Unless the crack is in submerged concrete, remove any water that can be seen by visual inspection from the cracks before the injection process, and remove water that appears during the injection process.
3. Ice in cracks—Do not inject cracks when the temperature of the concrete is below freezing and moisture conditions indicate the possibility of ice on the internal surfaces of the crack.
4. Temperature of the concrete—Do not inject adhesive if the temperature of the concrete is not within the range of application temperatures recommended by the manufacturer of the adhesive.

C. Surface Sealing

1. Surface seals—Apply a surface seal over all exterior faces of the crack that can be reached to contain the injection adhesive in the crack.

D. Injection

1. Inject cracks until epoxy fills entire crack.

E. Cleanup

1. Surface seal and ports—Remove surface seal and any installed injection ports that protrude from the surface of the concrete.
2. Spills and leaks—Clean and remove all spills and leaks of injection adhesive and stains caused by the injection adhesives.

3.05 PARTIAL DEPTH CONCRETE REPAIR – LESS THAN 2”

A. Preparation of Surfaces

1. Concrete surfaces to be repaired shall be prepared in accordance with section 3.01 and the following:
2. Concrete surfaces to which epoxies are to be applied shall be newly exposed parent concrete free of loose and unsound materials. Prepare surfaces by mechanical abrasion.

B. Inspection of Concrete Surfaces

1. Inspect all concrete surfaces prior to application of mortar. Surfaces shall be sound concrete and shall be free of any deleterious materials such as laitance, curing compounds, dust, dirt, and oil. Materials resulting from surface preparation shall be removed.
2. All concrete surfaces shall be dry as defined in the next paragraph unless a water-insensitive coating is used. Surface temperature shall be at least 40 degrees F to permit wetting of concrete surface by epoxy coating.
3. Evaluate moisture content for concrete by determining if moisture will collect at bond lines between old concrete and epoxy coating before epoxy has cured. This may be accomplished by taping a 4 x 4 ft polyethylene sheet to concrete surface. If moisture collects on underside of polyethylene sheet before epoxy would cure, then allow the concrete to

dry sufficiently to prevent the possibility of moisture between old concrete and new epoxy.

C. Mortar Mixes

1. Mix epoxy mortar in accordance with the manufacturer's written recommendations.

D. Mortar Application

1. Apply epoxy mortar to concrete surface by trowel or screed. Thickness shall be within the limits recommended by the manufacturer.
2. Work mortar into place and consolidation thoroughly so that all contact surfaces are wet by the mortar and entrained air is reduced to the level recommended by the manufacturer.
3. Finish surface of mortar to texture, color, and smoothness required for the specific applications.
4. Upon completion of the finishing operations, allow mortar to cure in accordance with manufacturer's recommendations.

E. Cleanup

1. Protect concrete surfaces, beyond limits of surface receiving mortar, against spillage.
2. Immediately remove any epoxy compound applied or spilled beyond desired areas. Perform cleanup with material designated by epoxy mortar manufacturer. Avoid contamination of work area.

3.06 PARTIAL DEPTH CONCRETE REPAIR – MORE THAN 2”

A. Preparation Of Surfaces

Concrete surfaces to be repaired shall be prepared in accordance with section 3.01 and the following:

1. The clean surface is not ready to receive repair concrete until it has been brought to a saturated, surface-dry condition. This condition is attained by saturating the surface to a depth that no concrete mixture water may be absorbed from the fresh concrete. Then, just prior to placing concrete against the surface, all free moisture (moisture capable of reflecting light) shall be removed from the prepared surface.

B. Application

1. Upon completion of concrete surface preparation in accordance with this section, an epoxy bonding agent shall be applied prior to placement of the concrete repair material.
2. Forms. - Forms shall be used for whenever necessary to confine the concrete and shape it to the required lines. The forms shall have sufficient strength to withstand the pressure resulting from placing operations, shall be maintained rigidly in position, and shall be sufficiently tight to prevent loss of mortar from the concrete.
3. Placing and finishing. - Repairs requiring forming, such as on steeply sloped or vertical surfaces, will be permitted only when the forming required is such that the bond coat can be applied and the concrete properly placed within the time period necessary to ensure that the applied bond coat will still be fluid, or tacky where permitted.
4. Immediately after application of the epoxy bond coat, while the epoxy is still fluid, concrete shall be spread evenly to a level slightly above grade and compacted thoroughly by vibrating, tamping, or both. Vibrators shall not be permitted to penetrate through the fresh concrete to the level of the fluid epoxy bond coat. Tampers shall be sufficiently heavy for thorough compaction. After being compacted and screeded, the concrete shall be given a wood float or steel trowel finish, as directed. Troweling, if required, shall result in a smooth, dense finish that is free from defects and blemishes. As the concrete continues to harden, the surface shall be given successive trowelings. The final troweling shall be performed after the surface has hardened to such an extent that no cement paste will adhere to the edge of the trowel.
5. Curing and protection. - The Contractor shall cure and protect all repairs from damage until acceptance by the Engineer. Concrete shall be protected against freezing for not less than 6 days from time of placement.
6. As soon as the concrete has hardened sufficiently to prevent damage, the surface shall be moistened by spraying lightly with water and then covering with sheet polyethylene, or by applying an approved curing compound, provided that curing compound shall be used for curing concrete whenever there is any possibility that freezing temperatures will prevail during the curing period. Sheet polyethylene, if used, shall be an airtight, nonstaining, waterproof covering which will effectively prevent loss of moisture from the concrete by evaporation. Edges of the polyethylene shall be lapped and sealed. The waterproof covering shall be left in place for not less than 14 days.

3.07 CONCRETE SKIM COAT REPAIR AND CONCRETE PROTECTIVE COATING

A. General

1. Existing debonded, loose, and flaking skim coat shall be removed to sound, bonded coating.
2. Existing wetwell interior walls, underside of new top slab, and floor (after slope modifications) shall be thoroughly cleaned of all dirt, debris, vegetation, oil and grease prior to application.

B. Surface Preparation

Concrete surfaces must be clean, free from grease, oil and loosely adhering particles. An open textured, sandpaper-like substrate is ideal (CSP-3). All surfaces must be saturated surface dry (SSD).

C. Mixing and Placement

The cementitious waterproofing and protective slurry mortar shall be mixed and placed in accordance with the manufacturer's written recommendations.

D. Curing

The cementitious waterproofing and protective slurry mortar shall be cured in accordance with the manufacturer's written recommendations.

END OF SECTION

SECTION 03 11 00

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section of the specifications covers the furnishing and installation of forms for cast-in-place concrete.

1.02 RELATED WORK:

- A. Section 01 45 23, STRUCTURAL TESTS AND INSPECTIONS
- C. Section 03 21 00, CONCRETE REINFORCEMENT
- D. Section 03 30 00, CAST-IN-PLACE CONCRETE

1.03 REFERENCES:

- A. The following standards form a part of this specification:
 - 1. AMERICAN CONCRETE INSTITUTE (ACI)
 - a. ACI 301 Standard Specifications for Structural Concrete
 - b. ACI 347 Recommended Practices for Concrete Formwork
 - 2. U.S. ARMY CORPS OF ENGINEERS (CE)
 - a. CE 03300 Cast-in-Place Concrete.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Forms for exterior surfaces which will be exposed to view after the work is completed, whether such surfaces are painted or unpainted, shall be new plywood stock, steel, tempered masonite, or other materials which will provide smooth concrete surfaces without subsequent surface plastering. Plastic or plastic-faced forms shall not be used, except with the prior approval of the Engineer.
- B. Form ties shall be cone type or equal, with waterstop, which leaves no metal closer than 2-inches to finished face of concrete.

- C. Form release agent shall be a non-staining, non-yellowing, non-toxic liquid free from kerosene and resins of the type recommended by the manufacturer of the forming system being used such as EZ strip by L&M Construction Chemicals, Omaha, NB and "Magic Kote" by Symons Corp., Des Plaines, IL or approved equal.
- D. Where steel adjacent to vertical faces of forms cannot be otherwise secured, mortar doughnuts shall be used to prevent steel from lying too close to the finish vertical faces of the concrete.

PART 3 - EXECUTION

3.01 PREPARATION:

Surfaces of forms to be in contact with concrete shall be greased with nonstaining form release compound. Wetting will not be accepted as a substitute. Approval of the Engineer shall be obtained before use of coated materials or liners in lieu of form release compound, except as modified herein.

3.02 CONSTRUCTION:

- A. For concrete surfaces which will be visible after completion of the structure, painted or unpainted, the type and the precise location of form ties, nails joints between form members, and any other features which will leave a visible trace in the finished concrete, will be subject to the approval of the Engineer.
- B. Formwork shall be so constructed, braced, or tied that the formed surfaces of the concrete will be perfectly true, smooth, and to the dimensions shown on the drawings. All forms used for circular sections shall be true arcs as indicated on the drawings. Short chords will not be acceptable. Form line shall present an uninterrupted surface conforming to radii indicated on the drawings.
- C. Forms shall be sufficiently tight to prevent leakage of mortar, and when necessary shall have temporary openings as required for thorough cleaning, and as required for introduction of concrete to avoid excessive free fall. Panels damaged in stripping or otherwise shall not be reused.
- D. Unless otherwise noted on the design drawings, forms shall be filleted and chamfered at all sharp corners, and exposed edges with a 3/4-inch chamfer. Chamfer shall not be used where masonry or other material will subsequently be installed flush with one of the adjacent surfaces of the concrete. Where a wash or slope is indicated on the drawings no additional chamfer is required.

3.03 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 30 percent of the ultimate strength prescribed by the design and not before reaching the recommended number of day-degrees [whichever is the longer].
- B. Shoring shall not be removed until the concrete has attained at least 70 percent of the specified strength and sufficient strength to support safely its own weight and the construction live loads upon it.
- C. Forms shall be removed in such a manner as not to impair safety and serviceability of the structure. Concrete exposed by form removal shall have sufficient strength not to be damaged by the removal operation.

END OF SECTION

SECTION 03 15 13

WATER-STOPS

PART 1 - GENERAL

1.01 WORK INCLUDED:

Furnish and install expanding bentonite-based waterstops as specified herein and illustrated on project drawings.

1.02 SYSTEM DESCRIPTION:

Water-stops shall be used at all construction and control joints, scheduled or unscheduled, which are subject to internal or external hydrostatic pressure.

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Shop drawings of the materials of this section.
- B. One 1-foot long sample of each type of water-stop.

1.04 RELATED SECTIONS:

- A. Section 01 45 23, STRUCTURAL TESTS AND INSPECTIONS
- B. Section 03 21 00 – CONCRETE REINFORCEMENT
- C. Section 03 30 00 – CAST-IN-PLACE CONCRETE

PART 2 - PRODUCTS

2.01 MATERIAL:

- A. Waterstop shall consist of sodium bentonite and butyl rubber compound formed into uniform coils.
- B. Bentonite Waterstops
 - 1. WATERSTOP-RX 101: 1" x 3/4" x 16'8" rolls of a flexible strip of bentonite and butyl rubber compound for use in concrete construction joints - not designed for expansion joints.
 - 2. WATESTOP-RX 101T: 1-1/4" x 1/2" x 20" trapezoidal rolls of flexible strip of bentonite and butyl rubber compound with a reinforcing poly scrim for use in concrete construction joints - not designed for expansion joints.

3. WATERSTOP-RX 102: 3/4" x 3/8" x 33'4" rolls of flexible strip of bentonite and butyl rubber compound for use in concrete construction joints - not designed for expansion joints.

C. Adhesive

1. CETSEAL: A multipurpose UV stable single component polyether moisture cure sealant / adhesive.

PART 3 - EXECUTION

3.01 PREPARATION:

Comply with contract documents and manufacturer's product data, including product application and installation instructions.

3.02 SUBSTRATE INSPECTION AND CONDITIONS

- A. The installer shall examine conditions of substrates and other conditions under which this section work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected and are acceptable for compliance with manufacturer's warranty requirements.
- B. Installation shall not proceed when work areas are flooded or wet to the extent that would cause bentonite waterstop to hydrate prior to concrete encapsulation.

3.03 SURFACE PREPARATION

- A. Remove dirt, debris, oil, grease, cement laitance, or other foreign matter which will impair or negatively affect the installation of the waterstop. Protect adjacent material surfaces from damage or contamination from during installation operations.

3.04 GENERAL INSTALLATION GUIDELINES

- A. Install WATERSTOP-RX in all applicable vertical and horizontal cast-in-place concrete construction joints; and around applicable penetrations and structural members. Place WATERSTOP-RX to allow for minimum 3" (75 mm) concrete coverage on all sides (2" (50 mm) coverage for RX-102).
- B. Apply continuous bead of CETSEAL (typical bead diameter 3/16" (5 mm)) to dry, smooth concrete surface maintaining a minimum 3" (75 mm) depth within the concrete joint.

- C. Remove release paper from coil of WATERSTOP-RX. Firmly press the entire length of WATERSTOP-RX into the CETSEAL adhesive bead; resulting in the adhesive bead spreading to coat most of the bottom of the waterstop. Verify 3” (75 mm) minimum concrete coverage will be maintained over entire placement of waterstop. Place in maximum practical lengths to minimize coil end joints.
- D. Tightly butt coil ends together to form continuous waterstop. Do not overlap coil ends. Where required, cut coils with sharp knife or utility blade to fit coil ends together without overlapping.
- E. Following Steps 1-3, install waterstop around all applicable through wall pipes and mechanical penetrations; and around all applicable structural elements like metal H-Piles through the slab.
- F. Protect installed waterstop from prehydration prior to concrete placement and product encapsulation. Replace any waterstop material that exhibit significant expansion prior to concrete encapsulation.

3.05 CLEAN UP

- A. Clean areas where adjacent finished surfaces are soiled by work of this Section. Remove all tools, equipment and remaining product on-site. Dispose of section work debris and damaged product following all applicable regulations.

END OF SECTION

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SECTION 03 21 00

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section of the specification covers the furnishing and installation of reinforcement for cast-in-place concrete.

1.02 RELATED WORK:

- A. Section 01 45 23, STRUCTURAL TESTS AND INSPECTIONS
- B. Section 03 11 00, CONCRETE FORMWORK
- C. Section 03 30 00, CAST-IN-PLACE CONCRETE
- D. Section 04 20 00, UNIT MASONRY ASSEMBLIES

1.03 SYSTEM DESCRIPTION:

Materials and construction shall conform to ACI 318 and ACI 350 unless otherwise noted on the design drawings or modified herein.

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. The Contractor shall furnish the Engineer with complete checked, reinforcing steel shop drawings and bar lists. Shop drawing shall include grade of steel used as well as splice lengths.
- B. Mill test reports shall accompany drawings. Fabrication shall not commence until the drawings and mill test reports have been released by the Engineer.
- C. When fiber reinforcement is used, contractor shall submit manufacturer's data confirming that material meets the specification.

1.05 REFERENCES:

- A. The following standards form a part of these specifications:
 - 1. American Concrete Institute (ACI)
 - a. ACI 318 Building Code Requirements for Concrete
 - b. ACI 347 Recommended Practice for Concrete Formwork

- c. ACI 350 Environmental Engineering Concrete Structures
 - d. ACI SP-66 ACI Detailing Manual
2. American Society for Testing and Materials (ASTM)
- a. ASTM A185 Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
 - b. ASTM A497 Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement
 - c. ASTM A615 Deformed Billet-Steel Bars for Concrete Reinforcement
 - d. ASTM A706 Standard Specification for Deformed and Plain Low-Alloy Bars for Concrete Reinforcement
 - e. ASTM A767 Galvanized Reinforcing Steel Bars
 - f. ASTM A775 Epoxy-coated Reinforcing Steel Bars
 - g. ASTM A884 Epoxy-coated Welded Wire Fabric
3. American Welding Society (AWS)
- a. AWS 12.1 Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Steel reinforcing bars shall conform to ASTM A615, Grade 60, and A767 if galvanized, and A775 if epoxy-coated bars are specified.
- B. Welded steel wire fabric shall conform to ASTM A185 or ASTM A497 and ASTM A884 if epoxy-coated fabric is specified. Gauge and spacing of wires shall be as indicated on the drawings.
- C. Reinforcing steel shall be detailed in accordance with ACI SP-66 modified as applicable to conform to ACI 350.
- D. Reinforcement shall be accurately formed to the dimensions indicated on the drawings. Bars shall be shipped to the site with bars of the same size and shape, fastened in bundles with securely wired-on metal identification tags listing both size and mark.

- E. Any bar showing cracks after bending shall be discarded.
- F. Steel failing to meet the requirements of this specification or the drawings will be rejected and shall be removed from the site immediately.

PART 3 - EXECUTION

3.01 STEEL INSTALLATION:

- A. Before being placed in position, reinforcement shall be thoroughly cleaned of loose mill and rust scale, dirt, and other coatings (including ice), that reduce or destroy bond. When there is a delay in depositing concrete after reinforcement is in place, bars shall be reinspected and cleaned as necessary.
- B. After forms have been oiled, but before concrete is placed, all steel shall be securely wired in the exact position called for, and shall be maintained in that position until all concrete is placed and compacted. Chair bars and supports shall be provided in a number and arrangement satisfactory to the Engineer.
- C. Concrete blocks having a minimum bearing area of 2-inches by 2-inches and equal in quality to that specified for the slab, shall be used for supporting reinforcing bars for slabs on grade. Wood blocks, stones, brick chips, etc., shall not be used to support reinforcement.
- D. Metal supports shall be of types that will not penetrate the surface of formwork or slab and which will not show through or stain surfaces that are to be exposed to view, painted or unpainted.
- E. Welding of reinforcing bars will be permitted only where permission of the Engineer has been obtained in advance. Such welding shall be performed only under conditions established by the Engineer, and in accordance with AWS 12.1.
- F. Reinforcement, which is to be exposed for a considerable length of time after having been placed, shall be painted with a heavy coat of cement grout, if required by the Engineer.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 -GENERAL

1.01 GENERAL PROVISIONS:

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK:

- A. Work Included: This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes but not limited to the following:
1. Footings and foundation walls
 2. Slabs-on-grade
 3. Exterior slabs and sidewalks.
- B. Items To Be Installed Only: Not applicable.
- C. Items To Be Furnished Only: Not applicable.
- D. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 01 45 23, STRUCTURAL TESTS AND INSPECTIONS
 2. Section 03 11 00, CONCRETE FORMWORK
 3. Section 03 21 00, CONCRETE REINFORCEMENT
 4. Section 04 20 00, UNIT MASONRY
 5. Section 06 10 00, ROUGH CARPENTRY
 6. Section 07 26 00, VAPOR RETARDERS
 7. Section 31 00 00, EARTHWORK; Excavation and establishment of subgrade elevations.

1.03 SUBMITTALS:

- A. Refer to Section 01 33 23, SUBMITTALS for submittal provisions and procedures.

- B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, water-stops, joint systems, curing compounds, dry-shake finish materials, and others if requested by the Engineer or SER.
- C. Shop drawings for reinforcement detailing, fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 “Manual of Standard Practice for Detailing Reinforced Concrete Structures”. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing and supports for concrete.
- D. Concrete mix design for each mix specified. Supporting test data shall be submitted if requested.
 - 1. Submit alternate mix designs when the characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
 - 2. Indicate the amounts of mixing water to be withheld for later addition at the Project site.
- E. Proposed method of curing and associated products.
- F. Proposed precautions for hot weather and cold weather concreting.
- G. Samples: For vapor retarder.
 - 1. Submit samples of materials as requested by the Engineer or SER, including names, sources, and descriptions.
- H. Laboratory test reports for concrete materials and mix design test.
- I. Material test reports for the following, from a qualified testing agency, indicating compliance with specification requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- J. Material certificates for each of the following, signed by the manufacturers:
 - 1. Cementitious material.
 - 2. Admixtures
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Non-metallic shrinkage resistant grout.
 - 6. Curing compounds.

7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Vapor retarders.
 11. Semi-rigid joint filler.
 12. Joint-filler strips.
 13. Repair materials.
- K. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- L. Qualification Data: For Installer and Manufacturer.
- M. Minutes of pre-installation conference.

1.04 QUALITY ASSURANCE:

- A. Installer Qualifications: A qualified installer who employs on the Project personnel qualified as ACI certified Flatwork Technician and Finisher and a supervisor who is an ACI certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mix concrete products that complies with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency for Mix Design Qualifications: An independent agency, registered in the State of New Hampshire as an approved testing agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician – Grade 1. The Testing Agency Laboratory supervisor shall be an ACI certified Concrete Laboratory Testing Technician – Grade II.
- D. Source Limitations: Obtain each type of class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. ACI Publications:

1. Comply with the following unless modified by requirements in the Contract Documents:
 - a. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
 - b. ACI 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete."
 - c. ACI 214, "Evaluation of Strength Test Results of Concrete."
 - d. ACI 301, "Specification for Structural Concrete."
 - e. ACI 304, "Guide for Measuring, Mixing, Transporting and Placing Concrete."
 - f. ACI 305, "Hot Weather Concreting."
 - g. ACI 306, "Cold Weather Concreting."
 - h. ACI 308, "Guide to Curing Concrete."
 - i. ACI 309, "Guide for Consolidation of Concrete."
 - j. ACI 311.1, "ACI Manual of Concrete Inspection."
 - k. ACI 315, "Details and Detailing of Concrete Reinforcement."
 - l. ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
 - m. ACI 347, "Guide for Formwork for Concrete."
 - n. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures"
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract.

F. American Society for Testing and Materials (ASTM):

1. ASTM C309 "Liquid Membrane-Forming Compounds for Curing Concrete."
2. ASTM C494 "Standard Specification for Chemical Admixtures for Concrete."
3. ASTM C979 "Standard Specification for Pigments for Integrally Colored Concrete."

G. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M194 "Chemical Admixtures."

H. Pre-installation Conference: Conduct a conference at the Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Structural Engineer.
 - f. Independent testing agency responsible for field testing.
 - g. Owner's Authorized Representative.
 - h. Engineer.
2. Review inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint filler strips, semi-rigid joint fillers, forms and form removal limitations, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor slab and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.05 DELIVERY, STORAGE, AND HANDLING:

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

PART 2 -PRODUCTS

2.01 FORM-FACING MATERIALS:

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
- B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Use only non-metallic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal for Architecturally Exposed Concrete (Concrete Exposed to View).
- E. Furnish units that will leave no corrodible metal closer than 1-inch to the plane of exposed concrete surface.
- F. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.02 STEEL REINFORCEMENT:

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
 - 1. Provide reinforcing bars conforming to ASTM A706, Grade 60, deformed, if welding is required.
 - 2. Reinforcement at splash pads shall be zinc coated per bars per ASTM A 767.
- B. Plain Steel Wire: ASTM A 82, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.03 FIBER REINFORCEMENT

- A. When called for on the drawings, concrete engineered reinforcing fibers shall be polypropylene, collated, fibrillated fibers from Fibermesh Co., 4019 Industry Drive, Chattanooga, TN; Forta Corporation, One Hundred Forta Drive, Grove City, PA; or approved equal. Only fibers designed and manufactured specifically for use in concrete from virgin polypropylene and so certified by the manufacturer shall be acceptable.

2.04 NON-METALLIC SHRINKAGE RESISTANT GROUT:

- A. Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for

application and a 30-minute working time. The minimum ultimate compressive strength of the grout shall be 5000 psi at 7 days and 7500 psi at 28 days.

2.05 REINFORCEMENT ACCESSORIES:

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolster, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice", of greater of compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless steel bar supports.
 - 2. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs. Concrete bricks may be used to support reinforcing steel where application allows.

2.06 ANCHOR RODS

- A. Anchor Rods: ASTM F 1554, Grade 55 (weldable), Hot Dipped Galvanized per ASTM A 153. Headed type unless otherwise noted. Provide suitable nuts in accordance with ASTM F1554 and ASTM A563 and washers in accordance with ASTM F436. Nuts and washers shall be hot-dipped galvanized.

2.07 CONCRETE MATERIALS:

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout the Project:
 - 1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:
- B. Fly Ash: ASTM C 618, Class C or F.
- C. Ground Granulated Blast Furnace Slag: ASTM C 989, Grade 100 or 120.
- D. Cementitious Materials: Percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
 - 1. Fly Ash or Ground Granulated Blast Furnace Slag: 25 percent, minimum.

2. Combined Fly Ash and Pozzolan: 35 percent, maximum.
 3. Ground Granulated Blast Furnace Slag: 50 percent, maximum.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 35 percent.
- E. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
1. Maximum Coarse Aggregate Size: $\frac{3}{4}$ -inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- F. Water: ASTM C 94 and potable.

2.08 ADMIXTURES:

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494, Type A.
 2. Retarding Admixture: ASTM C 494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor, capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494, Type C.
1. Products:
 - a. Euclid Chemical Company; Eucon CIA.
 - b. Grace Construction Products, W.R. Grace & Co.; DCI.
 - c. BASF Admixtures, Inc.; Rheocrete CNI.
 - d. Sika Corporation; Sika CNI.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products:

- a. Grace Construction Products, W.R. Grace & Co.; DCI-S.
- b. Sika Corporation: Sika FerroGard 903
- c. Euclid Chemical: Eucon BCN

2.09 SLAB TREATMENTS:

A. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of Portland cement, graded quartz aggregate, and plasticizing admixture.

1. Products:

- a. Burke by Edoco; NonMetallic Floor Hardener.
- b. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Conshake 500.
- c. Dayton Superior Corporation; Quartz Tuff.
- d. Euclid Chemical Company; Surfex.
- e. Lambert Corporation; Colorhard.
- f. L&M Construction Chemicals, Inc.; Quartzpalte FF.
- g. Scofield, L.M. Company; Lithochrome Color Hardener.
- h. Symons Corporation, a Dayton Superior Company; Hard Top.

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products:

- a. Burke by Edoco; Titan Hard.
- b. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Intraseal.
- c. Curecrete Distribution Inc.; Ashford Formula.
- d. Dayton Superior Corporation; Day-Chem Sure Hard.
- e. Euclid Chemical Company; Euco Diamond Hard.
- f. Kaufman Products, Inc.; SureHard.
- g. L&M Construction Chemicals, Inc.; Seal Hard.

- h. Meadows, W.R., Inc.; Liqui-Hard.
- i. Symons Corporation, a Dayton Superior Company; Buff Hard.

2.10 CURING MATERIALS:

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, non-dissipating, certified by curing compound manufacturer to not interfere with bonding of floor coverings.

1. Products:

- a. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; High Seal.
- b. Dayton Superior Corporation; Safe Cure and Seal (J-19).
- c. Euclid Chemical Company; Diamond Clear VOX.
- d. Lambert Corporation; Glazecote Sealer-20.
- e. L&M Construction Chemicals, Inc.; Dress & Seal WB.
- f. Meadows, W.R., Inc.; Vocomp-20.
- g. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 200E.
- h. Sonneborn, Div. Of ChemRex; Kure-N-Seal.
- i. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.

- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products:

- a. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315 WB.
- b. Euclid Chemical Company; Super Diamond Clear VOX.
- c. Lambert Corporation; UV Safe Seal.
- d. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
- e. Meadows, W.R., Inc.; Vocomp-30.

f. Symons Corporation, a Dayton Superior Company; Cure & Seal 31
Percent E.

2.11 RELATED MATERIALS:

- A. Expansion and Isolation Joint Filler Strips: ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.0217-inch thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336-inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS:

- A. Repair Underlayment: Cement based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8-inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8-inch to 1/4-inch or coarse sand as recommended by the underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C 109.

- B. Repair Overlayment: Cement based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8-inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8-inch to 1/4-inch or coarse sand as recommended by the topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C 109.

2.13 CONCRETE MIXTURES, GENERAL:

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water cementitious materials ratio below 0.50.

4. Use retarding admixture in combination with Set accelerating Corrosion Inhibitor. Retarder is not required for non-set accelerating corrosion inhibitor.
5. Use corrosion inhibiting admixture in concrete mixtures where indicated.
6. Use moisture vapor reduction admixture on all slabs to receive floor finishes. Refer to Specification Section 03 05 10.
7. Use integral crystalline waterproofing admixture in concrete mixtures where indicated.

2.14 CONCRETE MIXTURES FOR ELEMENTS:

- A. Footings, Foundation Walls: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4-inches for concrete with verified slump of 2-inch to 4-inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
 5. Corrosion Inhibiting Admixture: Apply to all walls at a rate of 4 gallons per cubic yard of concrete.
- B. Interior Slabs-on-Grade, Curbs, and Equipment Pads: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 4500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4-inches for concrete with verified slump of 2-inch to 4-inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch.
 4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
 5. Corrosion Inhibiting Admixture: Apply to all walls at a rate of 4 gallons per cubic yard of concrete. Use at Restroom Building only.
 6. Provide moisture vapor reduction admixture on all slabs to receive floor finishes.
- C. Exterior Slabs, Sidewalks, and Above Grade Foundations (such as piers): Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 5000 psi at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.40.
3. Slump Limit: 4-inches for concrete with verified slump of 2-inch to 4-inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size
5. Corrosion Inhibiting Admixture: Apply to all slabs at a rate of 4 gallons per cubic yard of concrete.

2.15 FABRICATING REINFORCEMENT:

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

2.16 CONCRETE MIXING:

- A. Ready-Mix Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94, and furnish batch ticket information.
- B. When air temperature is between 85 and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Coordinate the installation of joint materials, vapor retarder, and other related materials with placement of forms and reinforcing.

3.02 FORMWORK:

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 1. Class A, 1/8-inch for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.

- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Chamfer exterior corners and edges of permanently exposed concrete as noted on plans.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, and screeds required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.03 EMBEDDED ITEMS:

- A. Forms for Slabs: Set edge forms, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting type screeds.

3.04 REMOVING AND REUSING FORMS:

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form removal operations and curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

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

3.05 STEEL REINFORCEMENT:

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire ties.

3.06 FIBER INSTALLATION:

- A. Fibermesh fibers shall be used in concrete as indicated on the drawings or as specified and in strict accordance with the manufacturer's recommendations as to type and amount. The fiber manufacturer or approved distributor shall provide the services of a qualified employee for pre-job meeting and initial job start up.

3.07 JOINTS:

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or approved by the Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2-inches into concrete.
 - 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

4. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge joint to a radius of 1/8-inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Terminate full-width joint filler strips not less than 1/2-inch or more than 1-inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants", are indicated.
 2. Install joint filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.08 CONCRETE PLACEMENT:

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause

seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6-inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for slabs in continuous operation, within limits of construction joints, until placement of panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 degrees F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, providing water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing of concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.09 FINISHING FORMED SURFACES:

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with minimum number of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view.

3.10 FINISHING SLABS:

- A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces.
- B. Broom Finish: Apply a broom finish to exterior platforms, steps, and ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.
- C. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to all surfaces with truck traffic according to manufacturer's written instructions and as follows:
 1. Uniformly apply dry-shake floor hardener at a rate of 100 lb. /100 sq. ft. unless greater amount is recommended by manufacturer.
 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener

application, uniformly distributing remainder of material, and embed by power floating.

3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.11 MISCELLANEOUS CONCRETE ITEMS:

- A. Filling In: Fill in holes and openings left in concrete, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTING AND CURING:

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Curing all slabs in the project with moisture curing. Keep surfaces continually moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in the widest practicable width, with sides and ends lapped at least 12-inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subject to heavy rainfall within three hours after initial applications. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 4. Curing and Sealing Compound: Apply uniformly to slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subject to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply second coat. Maintain continuity of coating and repair damage during curing period.
- D. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.13 LIQUID FLOOR TREATMENTS:

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment to concrete slabs exposed to view according to manufacturer's written instructions.
 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Comply with Manufacturer's written instructions for application.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.14 JOINT FILLING:

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.15 CONCRETE SURFACE REPAIRS:

- A. Defective Concrete: repair and patch defective areas when approved by the Engineer. Remove and replace concrete that cannot be repaired and patched to the Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than ½-inch in any dimension in solid concrete, but not less than 1-inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush coat holes and voids with bonding agent. Fill and compact patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by the Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01-inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14-days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Repair defective areas, except random cracks and single holes 1-inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least ¾-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 6. Repair random cracks and single holes 1-inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72-hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to the Engineer's approval.

3.16 FIELD QUALITY CONTROL:

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 1. Steel reinforcement placement.
 2. Verification of use of required design mixture.

3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample of each day's pour of each concrete mixture exceeding 5 cubic yards, but less than 25 cubic yards, plus one set for each additional 50 cubic yards or fraction thereof.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 degrees F and below and when 80 degrees F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31.
 6. Cast and laboratory cure five standard cylinder specimens for each composite sample.
 7. Compressive Strength Tests: ASTM C 39; test one set of two-laboratory-cured specimens at 7 days and one set of two specimens at 28 days. Test remaining specimen at 28 days if previous results are satisfactory or retain this specimen for 56 day testing if results are not satisfactory.
 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive strength tests equals or exceeds specified compressive strength and no compressive strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to the Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28 day tests.
1. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as the sole basis for approval or rejection of concrete.
 2. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive

strengths, or other requirements have not been met, as required by the Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as required by the Engineer.

3. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 4. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.17 GROUTING:

- A. Mix grout in accordance with the approved manufacturer's instructions to a consistency which will permit placement. Place grout so as to ensure complete bearing and elimination of air pockets.

3.18 TEST FOR WATERTIGHTNESS:

- A. All concrete shall be watertight against leakage or groundwater infiltration. Special care shall be taken in the construction joints and any noticeable leakage or seepage causing wet spots on the slabs shall be repaired by and at the expense of the Contractor and by methods approved by the Engineer.

END OF SECTION

SECTION 05 50 00

MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers all miscellaneous metal items required for the work, except as specified elsewhere.
- B. All miscellaneous metalwork shall be fabricated as detailed or approved and shall be installed complete with all necessary anchors, anchor bolts, eye bolts, guides, bolts and other accessories.
- C. In general, site and shop fabricated items are included under this section, and factory fabricated items excluded. This section includes but is not limited to: lintels, louvers, stairs, railings and posts, grating, hatches, frames and covers, loose metal frames, nosings, edgings, ladders, vents, protective grilles and frames, and all other site or shop fabricated metal items otherwise excluded.

1.02 RELATED WORK:

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE
- B. Section 08 34 83, FLOOR DOORS
- C. Section 09 90 00, PAINTING

1.03 QUALITY ASSURANCE:

- A. The drawings show the character and extent of the work required, but do not attempt to show all methods, materials, and details of construction, fastening, etc. Supplementary parts customarily necessary to complete an item, though such parts are not definitely shown or specified, shall be included as part of the item.
- B. Details of construction of the various items shall be submitted on the shop drawings. High quality construction with a neat, finished, and workmanlike appearance will be required.
- C. The size and spacing of screws, connectors, anchors, and similar items, and the size and dimensions of metal items stated herein shall apply in general; specific sizes and spacing of fasteners and dimensions of metal items listed on the drawings shall take precedence.
- D. Items supplied hereunder which are required to be built into the concrete, masonry, etc., shall be delivered to the site at locations as required by the Owner or Engineer, and as required by the overall construction schedule.

- E. Manufacturers of other products comparable in quality and type to those specified will be acceptable if satisfactory data on past performance and other required information is furnished by the Contractor, and if approved by the Engineer.
- F. Color galvanized system shall be guaranteed by manufacturer for 20 years.
- G. Contractor shall submit an affidavit to Engineer that materials used are protected from or will not be subject to galvanic action.

1.04 REFERENCES:

- A. The following standards from a part of these specifications, and indicate the minimum standards required:

American Institute of Steel Construction (AISC)

AISC Specification for Structural Steel Buildings

American Society for Testing and Materials (ASTM)

ASTM	A36	Structural Steel
ASTM	A53	Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
ASTM	A123	Zinc (Hot-Dip-Galvanized) Coatings on Iron and Steel Products
ASTM	A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM	A239	Test for Uniformity of Coating by the Preece Test (Copper Sulfate Dip) on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM	A307	Carbon Steel Externally and Internally Threaded Standard Fasteners
ASTM	A366	Steel, Carbon, Cold-Rolled Sheet, Commercial Quality
ASTM	A525	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements
ASTM	A569	Steel Carbon (0.15 Maximum Percent) Hot-Rolled Sheet and Strip, Commercial Quality
ASTM	B221	Aluminum-Alloy Extruded Bars, Rods, Shapes and Tubes
ASTM	B308	Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
ASTM	C478	Precast Reinforced Concrete Manhole Sections

American Welding Society (AWS)

AWS D1.1 Structural Welding Code Steel

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Before fabricating or assembling any aluminum or stainless steel items, samples indicating full range of finish, color, and texture to be supplied shall be submitted to the Engineer for review.
- B. Shop drawings for all metalwork included in this section shall be submitted to the Engineer for review.
- C. The shop drawings shall be complete and checked, showing sizes, layout, method of assembly, fastenings, anchorage or connection with other work, finish, and coatings, etc. Shop drawings for aluminum work shall indicate alloys, temper and finish to be used.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. STEEL:

- 1. Materials, fabrication, and erection of miscellaneous steel sections shall conform to the applicable requirements of the AISC Specification.
- 2. Steel shapes, plates and bars shall conform to ASTM A36.
- 3. Sheet steel shall be cold-rolled or hot-rolled carbon sheet steel conforming to ASTM A366 or ASTM A569 as appropriate.
- 4. Steel pipe shall conform to ASTM A53.
- 5. Stainless steel shall be Type 304 unless otherwise indicated or specified.

B. ALUMINUM:

- 1. Aluminum shall be fabricated of plates, rolled or extruded shapes, sheets or castings conforming to the specific aluminum alloy and temper designation of the Aluminum Association as specified for the item.
- 2. Aluminum work shall be fabricated in a shop where the quality of work is of the highest standard for work of this type. All work shall be executed by mechanics skilled in the fabrication of aluminum, and shall be true to detail with sharp clean profiles, fitted with proper joints and intersections, and with finishes as specified.

3. The Contractor shall furnish the Engineer with mill certificates and a signed statement from the fabricator that all aluminum work furnished is of the proper alloys as specified.

C. FASTENERS:

1. Metalwork shall be complete, with all bolts, anchors, plates, washers, clamps, screws, studs and other such devices for proper securing and anchoring. Where positions of anchorages can be predetermined, they shall be shop-installed on the item; otherwise the material or equipment to be fastened shall be expansion bolted, toggle bolted, screwed, or otherwise fastened as shown on the drawings or called for herein.
2. Bolts and nuts for general anchorage and for miscellaneous ferrous metal assemblies and fasteners shall be galvanized, unfinished bolts conforming to ASTM A307 unless otherwise noted on the drawings.
3. Expansion bolts for use in concrete and masonry shall be of one manufacturer and shall be approved. Bolts shall be Kwik Bolt concrete anchors manufactured by Hilti Corp.; Trubolt+ manufactured by Red Head Concrete Anchoring Specialists; Wej-it manufactured by Wej-it Fastening Systems; or an approved equal product.
4. The centerline of expansion shields shall not be closer than 3-inches to the edge of any concrete or masonry in which they are placed.
5. Material for fasteners shall match or be galvanically compatible with the materials fastened. Washers, nuts and other accessories shall match the bolts.
6. Where the specific type, material, size and spacing of fasteners has not been called for on the drawings or in specifications, the fasteners proposed by the Contractor shall be reviewed by the Engineer. If, in the opinion of the Engineer, they are not in accordance with good safety practices, the contractor shall revise and resubmit appropriate fasteners.

D. ALUMINUM TUBES, ANGLES, CHANNELS, AND CLOSURE PLATES:

1. All aluminum tubes, structural shapes such as angles, channels, beams, etc., closure plates, and other aluminum items not usually furnished as integral parts of a system (stairs, hatches, etc.) shall conform to this specification. They shall be formed of aluminum alloy at least equal to 6063-T5, minimum yield strength 16 ksi and minimum tensile strength of 22 ksi.
2. The sizes and thickness of materials shall be designated on the drawings or as required for adequate structural strength.
3. All items shall be accurately machined, filed and fitted, and rigidly connected at all joints, corners and miters. All burrs or rough edges shall be removed. Exposed

surfaces shall be free from tool marks, scratches, or blemishes that would materially affect their appearance.

4. All items shall be installed plumb, level, and true and accurately fit with the existing building construction and/or the system (curtain wall, etc.) for which they are intended.
5. Fasteners shall be of 300 series stainless steel for fastening aluminum to aluminum or aluminum to steel. Bolts and expansion anchors used to fasten aluminum to masonry shall also be 300 series stainless steel.

E. ALUMINUM HATCHES/FLOOR DOORS, FRAMES AND COVERS:

1. Exterior hatches/floor doors, frames and covers shall be fabricated from steel or aluminum materials. Interior hatches/floor doors, frames and covers shall be fabricated from aluminum materials.
 - a. Fall through prevention system webbing consisting of Dupont Type 728 high tenacity system shall be provided for all access hatches and shall be "The Hatch Net 120" as manufactured by Safe Approach, Inc. of Auburn, ME or approved equal. Webbing shall be secured to access hatches as per manufacturer's specifications.
2. Aluminum floor hatches/floor doors, covers and frames shall be 1/4-inch extruded aluminum with built-in neoprene cushion and connectors bolted or welded to the exterior.
3. Door leaf shall be 1/4-inch aluminum checkered plate reinforced with steel or aluminum stiffeners as required.
4. Hinges shall be heavy bronze or stainless steel pintle hinges, compression spring operators enclosed in telescopic tubes, with positive snap latch with turn handles.
5. The doors shall open to 90 degrees and lock automatically in that position.
6. A vinyl grip handle shall be provided to release and close the cover with one hand. A removable key wrench shall be provided.
7. Doors shall be built to withstand H-20 wheel loading and be equipped with a snap lock and removable wrench lift handle.
8. Hardware shall be cadmium plated or stainless steel and factory finish shall be a prime coat of red oxide applied to steel doors and frames, or aluminum mill finish with bituminous coating shall be applied to the exterior of the aluminum frames or stainless steel for corrosive or explosive atmosphere areas.

9. Hatches shall be fabricated in accordance with the details shown on the drawings. Hatch covers and frames shall be manufactured by Bilco Co., New Haven, Connecticut; Inryco/Milnor, Lima, Ohio; U.S.F. Fabrication, Hialeah, Florida; or an approved equal.
10. Hatches shall be equipped with a channel and drain type frame to prevent penetration of raw water into the system.
11. The manufacturers shall guarantee against defects in material or workmanship for a period of five years from date of Owner's acceptance.

F. ALUMINUM LOUVERS:

1. Louvers shall be of extruded aluminum, with frames and blades fabricated from 6063-T5 aluminum alloy of the depth and sizes indicated on the drawings. Louver blades shall be the stormproof type. Louvers with gravity operating dampers or manually operated blades shall be furnished as shown on the drawings or as specified under other sections of these specifications. The head, sill, and jamb members shall be fabricated from identical structural members and shall be provided with an integral caulking slot and retaining head. Extruded sill extensions shall be furnished and installed with the louvers. All fastenings shall be stainless steel or aluminum.
2. The frame and blades of the fixed louvers shall be a minimum thickness of 0.081 inches and shall be provided with reinforcing bosses.
3. All louvers shall have insect screens attached to the interior. Insect screen shall be 18 x 14 mesh aluminum screening, 0.0123 diameter and 0.5056 clad. Frames shall be rolled aluminum with mitered corners secured with corner clips. Insect screens shall be manufactured by Construction Specialties, Inc., Cranford, NJ, or an approved equal.
4. Fixed louvers shall have heavy-duty bird screen attached to interior of louver, as indicated on the drawings. Screening shall be intercrimp aluminum wire secured in 10 B&S gage extruded frames. Mesh shall be 0.1-inch 0.092 intercrimp wire. Frames shall be rewirable. Heavy-duty bird screens shall be manufactured by Construction Specialties, Inc., Cranford, NJ, or an approved equal.

PART 3 - EXECUTION

3.01 GALVANIZING:

A. Hot-Dip Galvanizing:

1. Provide a coating for iron and steel fabrication applied by the hot-dip process. The galvanizing bath shall contain .05-.09% nickel. Immediately before galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The use of the wet

kettle process is prohibited. Comply with ASTM A-123 for fabricated products and ASTM A-153 for hardware. Provide thickness of galvanizing specified in referenced standards. Provide coating by Duncan galvanizing or approved equal.

- B. The Contractor shall be responsible for determining if any fabricated items are not suitable to be hot-dip galvanized and shall notify the Engineer in writing.
- C. Surfaces of metal to be galvanized shall be free from all dirt, grease, rust and moisture. Burrs and sharp projections shall be removed from edges, holes, etc., before galvanizing. Fabricated items shall be galvanized after fabrication.

3.02 WELDING OF STEEL:

Welding of steel shall be done in accordance with the AWS Code. Welds shall be continuous along entire line of contact, except where plug or tack welding is noted. Exposed welds shall be ground smooth.

3.03 WELDING OF ALUMINUM:

Welding of aluminum shall be done in accordance with the AWS "Welding Aluminum" as reprinted from the Welding Handbook. Aluminum shall be fusion welded by the inert gas-shielded-arc method. Where appearance is not a factor and anodizing is not required, alloy 4043 rods may be used. For appearance match, rods shall be of an alloy similar to the alloy being welded.

3.04 FABRICATION AND ERECTION:

- A. Metalwork shall be complete, with all necessary bolts, nuts, washers, anchors, plates, fastenings, and other fittings. To the extent possible, holes for attachment of blocking, clip angles, etc. shall be shop punched. Where shop punching is impracticable, holes shall be field drilled. Burned holes will not be permitted.
- B. Material shall be straight, accurately fabricated with joints neatly framed, square, and well-riveted, bolted, or welded.
- C. Metalwork to receive hardware shall have all cutouts and attachments accurately made using the hardware itself or templates where necessary.
- D. Metalwork shall be accurately set and secured in position, with lines plumb and level and surfaces flush and square, or as otherwise required to conform to the structure as shown on the drawings.
- E. Wherever possible, all metalwork shall be built into the masonry work and shall have sufficient anchors, well- fastened. Anchors shall be welded to steelwork and shall be staggered where attached to structural shapes. Metal- work impracticable to set before masonry is built shall be anchored to it with approved expansion bolts set in solid masonry units or in concrete.

- F. Miscellaneous metalwork shall be plainly marked to indicate its location in the structure.

3.05 ALUMINUM WORK PROTECTION:

- A. Aluminum surfaces, which after erection are to be in contact with wood or treated wood, shall be given a heavy brush coat of aluminum-pigmented bituminous paint or two (2) coats of aluminum metal and masonry paint.
- B. Aluminum surfaces, which after erection are to be in contact with masonry or concrete, shall be given a heavy brush coat of alkali-resistant bituminous paint.
- C. Aluminum surfaces which after erection are to be in contact with dissimilar metals, other than zinc or stainless steel, shall receive a heavy brush coat of zinc chromate primer, followed by two (2) coats of aluminum metal and masonry paint, or shall receive a heavy brush coat of alkali-resistant bituminous paint.
- D. Aluminum surfaces which are to be exposed to the weather, including anodized surfaces, shall receive two sprayed-on shop coats of water-white methacrylate lacquer, capable of withstanding the action of lime mortar for at least one week in an atmosphere of 100 percent humidity at room temperature. Surfaces shall be perfectly clean and dry before lacquering.
- E. Prior to the application of any of the above coatings, any and all areas where the paint has been damaged by abrasion or other cause shall be cleaned and repainted as required so that the aluminum will have a complete protective paint film when brought into contact with the material against which it is being protected.
- F. Before application of any coating, the surface shall be cleaned of all dirt, heavy deposits of grease or oil, and other foreign substances such as paint, lacquer, tape, moisture, or other material, which might interfere with the adhesion of the coating to be applied. Aluminum shall be left in a clean condition. Cleaning methods shall employ steam, mild soaps, mild detergents, or solvents such as kerosene, or naphtha. Lacquered surfaces may be cleaned with a mineral solvent or turpentine. Thorough rinsing with clean water and drying with clean, soft cloths shall follow any of the above cleaning methods. No other cleaning method may be used without the specific permission of the Engineer.
- G. After suitable cleaning, all aluminum work shall be given an approved shop coating of methacrylate lacquer to protect the surface from stain. The protective coating of lacquer on all aluminum work worn off due to handling or erection shall be replaced by a new coating of lacquer of the same type.
- H. During construction, precautions shall be taken to prevent damage to the aluminum work from splashing or the accumulation of paint, concrete, mortar, or other similar materials, or from staining adjacent surfaces during cleaning operations. Any staining or damage that does occur shall be immediately and completely removed.

- I. Each piece of aluminum in transit and in storage shall be individually wrapped with a non-scratching material, with the joints securely sealed. Wrapping shall completely cover and protect each item. Storage shall be out of the weather, protected from moisture, and with adequate ventilation around each piece of aluminum.

3.06 PAINTING:

- A. Ferrous metals of this section, except for galvanized or stainless steel shall be shop primed in accordance with the following:
 - 1. Submerged service components shall be sandblasted clean in accordance with SSPC-SP-10, Near White, immediately prior to priming.
 - 2. Non-submerged service components shall be sandblasted clean in accordance with SSPC-SP-6, Commercial Grade, immediately prior to priming.
 - 3. Shop primer, except as otherwise noted, shall be one spray applied coat with dry film thickness of 3.5 to 4.5 mils of Tnemec 66 Boston Gray Primer by Tnemec Co.; or Aquapun by PPG, Inc; or approved equal.
 - 4. Portions of ferrous metals to be embedded in concrete or masonry shall be given a heavy brush coat of alkali resistant bituminous paint.
 - 5. Scratches or abrasions in the shop coat and areas at field welds, bolts, nuts and other unpainted areas shall be touched up after erection with the paint specified for the shop coat. Cold galvanized paint shall be used for touch up of galvanized surfaces. Paint shall be one of the following; Sealube Co., ZRC; Galvicon Corp., Galvicon; Stanley Chemical Div., Zinc Shield; Duncan Galvanizing Corp., ZIRP; or an approved equal.
 - 6. Shop and field prime paint systems shall be compatible with finish coat.
- B. Aluminum louvers shall be finished with polyvinylidene fluoride (PVDF) colored opaque fluorocarbon coating. PVDF resins shall be "Kynar 500" or "Hylar 5000."

END OF SECTION

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Wood blocking, cants, and nailers.
 - 2. Wood furring and grounds.
 - 3. Wood sleepers.
 - 4. Plywood backing panels.

1.03 DEFINITIONS:

- A. Boards or Strips: Lumber of less than 2-inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2-inches nominal size or greater but less than 5-inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. Timber: Lumber of 5-inches nominal size or greater in least dimension.

1.04 ACTION SUBMITTALS:

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.05 INFORMATIONAL SUBMITTALS:

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

1.06 QUALITY ASSURANCE:

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.07 DELIVERY, STORAGE, AND HANDLING:

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

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL:

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness unless otherwise indicated.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER:

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring and similar concealed members in contact with masonry or concrete.
 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 4. Wood framing members that are less than 18-inches above the ground in crawlspaces or unexcavated areas.
 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 FIRE-RETARDANT-TREATED MATERIALS:

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings, and the following:
 - 1. Framing for raised platforms.
 - 2. Concealed blocking.
 - 3. Framing for non-load-bearing partitions.
 - 4. Framing for non-load-bearing exterior walls.
 - 5. Roof construction.
 - 6. Plywood backing panels.

2.04 MISCELLANEOUS LUMBER:

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Cants.
 5. Furring.
 6. Grounds.
 7. Utility shelving.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber any of the following species:
1. Hem-fir (north); NLGA.
 2. Mixed southern pine or southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.
 4. Hem-fir; WCLIB or WWPA.
 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 6. Western woods; WCLIB or WWPA.
 7. Northern species; NLGA.
 8. Eastern softwoods; NeLMA.
- C. Utility Shelving: Lumber with 15 percent maximum moisture content of any of the following species and grades:
1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
 2. Mixed southern pine or southern pine; No. 1 grade; SPIB.
 3. Hem-fir or hem-fir (north); Select Merchantable or No. 1 Common grade; NLGA, WCLIB, or WWPA.
 4. Spruce-pine-fir (south) or spruce-pine-fir; Select Merchantable or No. 1 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 4. Eastern softwoods; No. 2 Common grade; NeLMA.
 5. Northern species; No. 2 Common grade; NLGA.
 6. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.05 PLYWOOD BACKING PANELS:

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.06 FASTENERS:

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.07 METAL FRAMING ANCHORS:

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Phoenix Metal Products, Inc.
 - 2. Simpson Strong-Tie Co., Inc.
- B. Allowable design loads, as published by manufacturer, shall meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. 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.
- D. 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-preserved-treated lumber and where indicated.
- E. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 316.
 1. Use for exterior locations and where indicated.
- F. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.
- G. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch- minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108-inch thick.

2.08 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32-inch; selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4-inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025-inch.
- D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- E. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL:

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Install shear wall panels to comply with manufacturer's written instructions.
- F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- H. Do not splice structural members between supports unless otherwise indicated.
- I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16-inches o.c.
- J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96-inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96-inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- K. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- L. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.

- M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- N. 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).
 - 2. ICC-ES evaluation report for fastener.
- O. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- P. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
 - 1. Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
 - 2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
 - 3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.02 INSTALLATION OF WOOD BLOCKING AND NAILERS:

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 INSTALLATION OF WOOD FURRING:

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24-inches o.c.
- C. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

- D. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 16 00

SHEATHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Composite nail base insulated roof sheathing.
4. Underlayment.
5. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry"
2. Section 07 25 00 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.03 ACTION SUBMITTALS:

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.04 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For Installer.
- B. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.
- C. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated plywood.
- E. Field quality-control reports.

1.05 QUALITY ASSURANCE:

- A. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build integrated mockups of exterior wall assembly 150 sq. ft. incorporating backup wall construction, window, storefront, door frame and sill, ties and other penetrations, and flashing to demonstrate crack and joint treatment and sealing of gaps, terminations, and penetrations of air-barrier sheathing assembly.
 - a. Coordinate construction of mockups to permit inspection and testing of sheathing before external insulation and cladding are installed.
 - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 - c. If Architect determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Testing Agency Qualifications:
 - 1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
 - 2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified according to ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

1.06 DELIVERY, STORAGE, AND HANDLING:

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

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.02 WOOD PANEL PRODUCTS:

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.03 PRESERVATIVE-TREATED PLYWOOD:

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing

2.04 FIRE-RETARDANT-TREATED PLYWOOD:

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-

test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified.[For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.]
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings, and the following:
 - 1. Roof sheathing
 - 2. Wall Sheathing
 - 3. Elec Panel Backer Panels

2.05 WALL SHEATHING:

- A. Plywood Sheathing: Exposure 1, Structural I.
 - 1. Span Rating: Not less than 32/16.
 - 2. Nominal Thickness: Not less than 1/2-inch.

2.06 ROOF SHEATHING:

- A. Plywood Sheathing: Exposure 1, Structural I.
 - 1. Span Rating: Not less than 32/16
 - 2. Nominal Thickness: Not less than 5/8-inch.

2.07 Electrical Panel Backer Panels:

A. Plywood Sheathing Requirements

1. Span Rating: Not Required
2. Nominal Thickness: Not less than ¾-inch.
3. Fire retardant Treated Plywood (FRTW)
4. A-C Plywood

2.08 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING:

A. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type II, Class 1, with DOC PS 2, Exposure 1 oriented strand board adhered to spacers on one face.

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. Atlas Roofing Corporation - MPS.
 - b. Hunter Panels.
 - c. Johns Manville; a Berkshire Hathaway company.
2. Polyisocyanurate-Foam Thickness: 5-inches, approx. R20.5. (Total roof assembly with insulation below cool vent to be R-30.)
3. Plywood Sheathing Nominal Thickness: ¾-inch, fire treated
4. Spacers: Wood furring strips or blocks not less than ¾-inch thick and spaced not more than 16-inches.

2.09 FASTENERS:

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329-inch thick, use screws that comply with ASTM C1002.
 - 2. For steel framing from 0.033 to 0.112-inch thick, use screws that comply with ASTM C954.

- G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.010 MISCELLANEOUS MATERIALS:

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL:

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.

- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.02 FIELD QUALITY CONTROL:

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Testing and Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 - 3. Termination mastic has been applied on cut edges.
 - 4. Strips and transition strips have been firmly adhered to substrate.
 - 5. Compatible materials have been used.
 - 6. Transitions at changes in direction and structural support at gaps have been provided.
 - 7. Connections between assemblies (sheathing and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 8. All penetrations have been sealed.
- D. Tests: As determined by testing agency from among the following tests:
 - 1. Air-Leakage-Location Testing: Air-barrier sheathing assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers
 - 2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E783
- E. Air barriers will be considered defective if they do not pass tests and inspections.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- G. Prepare test and inspection reports.

END OF SECTION

SECTION 06 17 53

PREFABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section of the specification covers design, furnishing of materials, fabrication, delivery and installation of the prefabricated wood trusses, including furnishing and installing all miscellaneous parts required to complete the truss system, such as bridging (temporary and permanent), bracing, connectors, anchors, metal hangers, and any other items necessary to the complete installation.

1.02 SYSTEM DESCRIPTION:

A. DESIGN CRITERIA:

1. Allowable deflection: $L/240$
2. Ground snow load: 40 lbs./s.f. before adjustment for configuration.
3. Top chord dead load: 10 lbs/s.f.
4. Bottom chord dead load: 12 lbs./s.f., 40 psf at catwalk
5. Bottom chord live load: 40 lbs/s.f. at catwalk
6. Wind pressure or suction: 21 lbs/s.f. acting perpendicular to the plane of the roof.

1.03 RELATED WORK:

- A. Section 06 10 00, ROUGH CARPENTRY

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01330 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Computations or certification of design stamped by a professional engineer registered in the state where the project is located, for record only.

- B Complete truss shop and erection drawings, containing the following data:
1. Design and fabrication data.
 2. Connector: gauge, sizes of connectors, and name of manufacturer.
 3. Lumber specifications.
 4. Pitch, span and spacing of trusses.
 5. Design loadings and allowable unit stress increase, if any.
 6. Size and location of all connector plates.
 7. Truss supports and anchorage details.
 8. Camber, if any.
 9. Permanent bracing and bridging.
 10. Handling and erection instructions.
- C. Certificate of wood treatment upon delivery of treated wood product. Treated wood product shall bear appropriate American Wood Preservers Bureau (AWPB) quality mark.
- D. Do not order materials or begin fabrication or installation until the Engineer has authorized it.

PART 2 - PRODUCTS

2.01 LUMBER:

- A. All lumber used for truss members shall conform to the published stress ratings for the species and grades as set out in the official grading rules of the appropriate lumber associations or as listed in the referenced specifications.
- B. The moisture content of all lumber shall be within the proper limits, as stated in the reference specifications, but shall not in any case, exceed 15% nor be less than 7% at the time of the fabrication. All lumbers to be kiln dried.
- C. All lumber shall conform to the specified and fully recognized nominal sizes shown on truss engineering designs. All members shall be cut from lumber which bears the proper grade-mark stamp of a recognized grading association or licensed lumber inspection agency. No lumber shall be used which does not conform to the proper dimensions and grades.

D. WOOD FIRE RETARDANT TREATMENT:

1. Exposed wood trusses shall receive fire-retardant treatment conforming to American Wood Preservers Association, AWPA Standard C20 for lumber.
2. Fire retardant treated lumber shall bear UL label and shall have UL Fire-Hazard Classification "FR-S", when tested in accordance with ASTM E84.
3. Material to receive interior grade fire-retardant treatment shall be pressure impregnated with "Dricon" fire-retardant chemicals manufactured by Hickson Corporation, Atlanta, Georgia, in accordance with manufacturer's instructions.
 - a. Material to receive interior grade fire retardant treatment shall be as indicated, specified, and as required by Article 9 of Massachusetts State Building Code.

2.02 CONNECTORS:

- A. All truss connector plates shall be manufactured from prime commercial quality galvanized sheet steel of no less than 18 gauge thickness. The corrosion resistant coating shall be 1.25 oz. per sq. ft. commercial class hot dipped galvanized.
- B. The connector plates shall be manufactured so as to have a series of nail-like projections and each projection shall have essentially parallel sides throughout its length, with no offsets, and the end shall be shaped to a blunt point or a wedge. The length of each nail-like projection shall be not less than five times the dimensions of its greater width and the projection shall be formed in a manner which permits it to separate rather than to cut wood fibers, in accordance with accepted nailing techniques.
- C. Each plate shall bear the stamped name of its manufacturer, which shall be the same as the company furnishing the approved truss engineering designs. Where field connections of truss sub-assemblies are necessary, special nail-on splice plates are acceptable, provided the plate sizes and positions are shown on the truss engineering designs as approved by a professional engineer.

2.03 FABRICATION:

- A. All trusses and other roof structural components shall be fabricated in a properly equipped manufacturing facility of a permanent nature. They shall be manufactured by experienced workmen, using precision cutting and truss fabricating equipment, under the direct supervision of a qualified foreman. All trusses shall be fabricated under strict rules of inspection and quality control, as the local code may require, open to inspection by the Engineer at all times.

- B. All truss members shall be accurately cut to length, angle and true to line to assure tight joints for the finished truss.
- C. All truss members and connector plates shall be accurately placed in special jigs and the members tightly clamped in place; remaining in that position until the connector plates have been pressed into the lumber simultaneously on both sides of the joints.
- D. No open joints which depend on the stiffness of the metal connector plate to transmit stresses, nor improperly fitting points will be permitted.
- E. Camber shall be built into the trusses, as noted on the engineering truss designs, by properly positioning the members in the fabrication jig.
- F. Each truss shall be permanently stamped with the name and address of the truss fabricator.

PART 3 - EXECUTION

3.01 HANDLING AND ERECTION:

- A. Fabricated trusses and sub-assemblies shall be handled with care so that they are not subject to damage. If the trusses are to be stockpiled or stored prior to erection, they shall be set in a vertical position, resting upon temporary bearing supports and braces so that they will not be subjected to unusual bending or to being tipped over.
- B. During erection, care shall be exercised to keep horizontal bending of the trusses at a minimum.
- C. Proper erection bracing shall be installed to hold the trusses true and plumb and in a safe condition until permanent truss bracing and bridging can be solidly nailed in place to form a structurally sound roof framing system. All erection and permanent bracing shall be installed and all components permanently fastened before the application of any loads, except the weight of the erectors.
- D. Field erection of the trusses shall include proper handling, safety precautions, temporary bracing, and any other safeguard or procedures consistent with good workmanship and good building erection practices.
- E. Framing anchors and/or truss hangers shall be provided by the contractor as shown on the engineering design drawings and erection drawings.
- F. During the entire construction period provision shall be made for adequate distribution of concentrated loads so that the carrying capacity of any one truss or other component is not exceeded.

3.02 ANCHORAGE:

- A. An anchorage system to provide hold-down capability for the trusses at the roof edge shall be installed along the walls of the building. This may be via either TECO "Ty-Down, Junior" clips, Simpson H1 or H2.5 "Hurricane Anchors" or approved equal.

END OF SECTION

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SECTION 06 20 13

EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. Section Includes:

- 1. Exterior cellular PVC trim.

B. Related Requirements:

- 1. Section 06 10 00 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view and for framing exposed to view.

1.03 DEFINITIONS:

- A. MDO: Plywood with a medium-density overlay on the face.

- B. PVC: Polyvinyl chloride.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

- 1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
- 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

- B. Samples: For each exposed product and for each color and texture specified.

- C. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

- D. Samples for Verification:
 - 1. For cellular PVC trim, with half of exposed surface finished; 50 sq. in..

1.05 INFORMATIONAL SUBMITTALS:

- A. Compliance Certificates:
 - 1. For lumber that is not marked with grade stamp.
 - 2. For preservative-treated wood that is not marked with treatment-quality mark.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Cellular PVC trim.
- C. Sample Warranties: For manufacturer's warranties.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.
 - 1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
 - 2. Provide for air circulation around stacks and under coverings.

1.07 FIELD CONDITIONS:

- A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL:

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

2.02 EXTERIOR TRIM:

A. Cellular PVC Trim: Extruded, expanded PVC with a small-cell microstructure, recommended by manufacturer for exterior use, made from UV- and heat-stabilized rigid material.

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. AZEK Building Products, Inc.
 - b. CertainTeed LLC; Saint-Gobain North America.
 - c. Kleer Lumber, LLC.
 - d. VERSATEX Building Products, LLC.
2. Density: Not less than 31 lb/cu. ft..
3. Heat Deflection Temperature: Not less than 130 deg F, according to ASTM D648.
4. Coefficient of Thermal Expansion: Not more than 4.5×10^{-5} inches/inch x deg F.
5. Water Absorption: Not more than 1 percent, according to ASTM D570.
6. Flame-Spread Index: 75 or less, according to ASTM E84.

2.03 MISCELLANEOUS MATERIALS:

A. Fasteners for Exterior Finish Carpentry (PVC Trim): Provide concealed fasteners in sufficient length to penetrate not less than 1-1/2-inches into wood substrate.

1. Provide coated, concealed fastener self-tapping screws with plugs to match selected PVC manufacturer PVC board color and texture.

Basis of Design to be "*Cortex Hidden Fastening System for PVC Trim*"

tel: 1800-518-3569, Web: <https://www.fastenmaster.com/products/cortex-loose-plugs-for-pvc-trim.html>

2. For applications not otherwise indicated, provide stainless steel fasteners.

B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

C. Adhesive for Cellular PVC Trim: Product recommended by trim manufacturer.

D. Flashing: Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

1. Horizontal Joint Flashing for Panel Siding: Preformed, stainless steel, Z-shaped flashing.
- E. Sealants: Latex, complying with ASTM C834 and applicable requirements in Section 07 92 00 "Joint Sealants," and recommended by sealant and substrate manufacturers for intended application.

2.04 FABRICATION:

- A. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.
- B. Ease edges of lumber less than 1-inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.
 1. Cut to required lengths and prime ends.
 2. Comply with requirements in Section 09 91 00, "PAINTING".

3.03 INSTALLATION, GENERAL:

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
 1. Do not use manufactured units with defective surfaces, sizes, or patterns.
- B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials.
 1. Use concealed shims where necessary for alignment.
 2. Scribe and cut exterior finish carpentry to fit adjoining work.

3. Refinish and seal cuts as recommended by manufacturer.
4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.04 INSTALLATION OF STANDING AND RUNNING TRIM:

- A. Install flat-grain lumber with bark side exposed to weather.
- B. Install cellular PVC trim to comply with manufacturer's written instructions.
- C. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary.
 1. Use scarf joints for end-to-end joints.
 2. Stagger end joints in adjacent and related members.
- D. Fit exterior joints to exclude water.
 1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
 2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.
- E. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.05 ADJUSTING:

- A. Replace exterior finish carpentry that is damaged or does not comply with requirements.
 1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
- B. Adjust joinery for uniform appearance.

3.06 CLEANING:

- A. Clean exterior finish carpentry on exposed and semiexposed surfaces.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.

3.07 PROTECTION:

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 06 64 00
PLASTIC PANELING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Plastic sheet paneling.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.04 QUALITY ASSURANCE

- A. Testing Agency: Acceptable to authorities having jurisdiction.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.02 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Composites, Inc.
 - b. Marlite.
 - c. Nudo Products, Inc.
 - 2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 3. Nominal Thickness: Not less than 0.075 inch
 - 4. Surface Finish: Smooth
 - 5. Color: As selected by Architect from manufacturer's full range.

2.03 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard two-piece, snap-on vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners and caps as needed to conceal edges.
 - 1. Color: As selected by Architect from manufacturer's full range.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- D. Adhesive: As recommended by plastic paneling manufacturer.
- E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.01 EXAMINATION

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

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

3.02 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches wide.
 - 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
 - 2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.03 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
 - 1. Drill oversized fastener holes in panels and center fasteners in holes.
 - 2. Apply sealant to fastener holes before installing fasteners.
- D. Install factory-laminated panels using concealed mounting splines in panel joints.
- E. Install trim accessories with adhesive and fasteners. Do not fasten through panels.
- F. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- G. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- H. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. Section Includes:

- 1. Extruded polystyrene foam-plastic board insulation.
- 2. Mineral-wool blanket insulation.

B. Related Requirements:

- 1. Section 07 21 19 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.

1.03 ACTION SUBMITTALS:

A. Product Data: For the following:

- 1. Extruded polystyrene foam-plastic board insulation.
- 2. Mineral-wool blanket insulation.
- 3. Mineral-wool board insulation.

1.04 INFORMATIONAL SUBMITTALS:

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

- 1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
- 2. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.01 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION:

- A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced.
 - 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. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. DuPont de Nemours, Inc.
 - d. Owens Corning.
 - 2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 - 3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
 - 4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - 5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.02 MINERAL-WOOL BLANKET INSULATION:

- A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type IA (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Owens Corning.

c. ROCKWOOL.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.03 INSULATION FASTENERS:

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

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. AGM Industries, Inc.
- b. Gemco.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

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. AGM Industries, Inc.
- b. Gemco.

2.04 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. 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.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.01 PREPARATION:

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

3.02 INSTALLATION, GENERAL:

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. 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.

3.03 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION:

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.04 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 07 21 00

SECTION 07 21 19

FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Closed-cell spray polyurethane foam.
- B. Related Requirements:
 - 1. Section 07 21 00 "Thermal Insulation" for foam-plastic board insulation.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.
- D. Compliance Submittal: Use of certain Hydrofluorocarbons in order to stay within the regulations of 310 CMR 7.76 for rigid insulation.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.01 CLOSED-CELL SPRAY POLYURETHANE FOAM

- A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.
 - 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. Carlisle Spray Foam Insulation.
 - b. Icynene-Lapolla; Icynene.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Master Builders Solutions.
 - 2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.02 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.02 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.

- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- D. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.03 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 07 21 19

SECTION 07 25 00

WEATHER BARRIERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:

- 1. Building wrap.
- 2. Flexible flashing.

1.03 ACTION SUBMITTALS:

- A. Product Data: For each type of product.
 - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.
- B. Shop Drawings: Show details of building wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.

1.04 INFORMATIONAL SUBMITTALS:

- A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.01 WATER-RESISTIVE BARRIER:

- A. Building Wrap: ASTM E1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 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. DuPont de Nemours, Inc.
 - b. Raven Industries, Inc.
 - c. TYPAR.
2. Water-Vapor Permeance: Not more than 30 perms per ASTM E96/E96M, Desiccant Method (Procedure A).
 3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E2178.
 4. Allowable UV Exposure Time: Not less than three months.
 5. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.02 FLEXIBLE FLASHING:

- A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030-inch.
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. DuPont de Nemours, Inc.
 - b. Protecto Wrap Company.
 - c. Raven Industries, Inc.
 2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
- B. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.
- C. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F1667.

PART 3 - EXECUTION

3.01 WATER-RESISTIVE BARRIER INSTALLATION:

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

1. Cut back barrier ½-inch on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

C. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

3.02 FLEXIBLE FLASHING INSTALLATION:

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION

SECTION 07 26 00

VAPOR RETARDERS

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Underslab Vapor Retarders

1.02 ACTION SUBMITTALS:

- A. Product Data: For each type of product.

1.03 INFORMATIONAL SUBMITTALS:

- A. Product test reports.

PART 2 - PRODUCTS

2.01 UNDER SLAB VAPOR BARRIERS:

A. Manufacturers and products:

1. Specified Product (Basis of Design): To establish a standard of quality, design and function desired, Drawings and specifications have been based on Raven Industries, Sioux Falls, SD, Product: "VaporBlock Plus VBP20".
2. Acceptable manufacturers: Subject to compliance with the requirements specified herein, products which may be incorporated in the work include, but are not limited to, the following:
 - a. Raven Industries, Sioux Falls, SD, product "VaporBlock Plus VBP20".
 - b. Stego Industries LLC, San Juan Capistrano, CA, product: "Stego Wrap (20 mil)".
 - c. Poly-America, Grand Prairie, TX, product: "Yellow Guard (20 mil)".

- B. Vapor barrier: Seven layer co-extruded gas and moisture barrier fabricated from polyethylene and EVOH resins, Class A

- C. Characteristics:

1. Minimum thickness: 20 mils.
2. Weight: 102 lbs/msf.
3. Permeance (new) when tested in accordance with ASTM E 154 (Sections 7): Less than 0.0098 perms (gr/ft²/hr/in-Hg).
4. Permeance (after conditioning) when tested in accordance with ASTM E 154 (Sections 8 and 11): Less than 0.0079 perms (gr/ft²/hr/in-Hg).
5. Tensile strength when tested in accordance with ASTM E 154 (Section 9): 58 lbf.
6. Impact resistance when tested in accordance with ASTM D 1709: 2,600 g.
7. Water vapor transmission rate when tested in accordance with ASTM E 96: 0.0040 grains/hr-ft².
8. Radon diffusion coefficient when tested K124/02/95: 1.1×10^{-13}m²/s.

2.02 ACCESSORIES:

- A. General: Staples, tape, adhesives and fasteners required for the proper and complete installation for work of this Section shall be as recommended by each respective manufacturers of each type of vapor barrier.
- B. Seam Tape: High density polyethylene tape or HDPE tape as recommended by vapor barrier manufacturer, with pressure sensitive adhesive. Minimum width 4 inches.
- C. Pipe Boots: Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.

PART 3 - EXECUTION

3.01 INSTALLATION OF VAPOR RETARDERS UNDER SLAB ON GRADE:

- A. Install vapor retarders over prepared grade. Lap joints a minimum of 12-inches and seal with manufacturer's recommended tape. Install second layer over pathways to equipment.
- B. Extend vapor retarder over footings and seal to foundation wall or grade beam with manufacturer's recommended tape.
 1. Extend vapor retarder vertically minimum 24-inches above top of footing.
- C. Seal around penetrations such as utilities and columns in order to create a monolithic, airtight membrane at grade surface, perimeter, and all vertical penetrations.

END OF SECTION

SECTION 07 31 13

ASPHALT SHINGLE ROOF

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Metal flashing and trim.

B. Related Requirements:

1. Section 06 10 00 ROUGH CARPENTRY for plywood roof deck.
2. Section 07 62 00 SHEET METAL FLASHING AND TRIM
3. Section 07 72 00 ROOF ACCESSORIES

1.03 DEFINITIONS

- A. Roofing Terminology: See ASTM D1079 for definitions of terms related to roofing Work in this Section.

1.04 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:

1. Asphalt shingles.
2. Underlayment materials.

3. Ridge vents.
 4. Asphalt roofing cement.
 5. Elastomeric flashing sealant.
- B. Shop Drawings: For metal flashing and trim.
- C. Samples: For each exposed product and for each color and blend specified, in sizes indicated.
1. Asphalt Shingles: Full size.
 2. Ridge and Hip Cap Shingles: Full size.
 3. Ridge Vent: 12-inch- long Sample.
 4. Exposed Valley Lining: 12 inches square.
- D. Samples for Initial Selection:
1. For each type of asphalt shingle indicated.
 2. For each type of accessory involving color selection.
- E. Samples for Verification: For the following products, in sizes indicated:
1. Asphalt Shingles: Full size.
 2. Ridge and Hip Cap Shingles: Full size.
 3. Ridge Vent: 12-inch- long Sample.
 4. Exposed Valley Lining: 12 inches square.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by manufacturer and witnessed by a qualified testing agency
- C. Research Reports: For synthetic underlayment, from ICC-ES, indicating that product is suitable for intended use under applicable building codes.
- D. Sample Warranty: For manufacturer's materials warranty.

1.07 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For asphalt shingles to include in maintenance manuals.
- B. Materials warranties.
- C. Roofing Installer's warranty.

1.08 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Asphalt Shingles: 100 sq. ft. of each type and in each color and blend, in unbroken bundles.

1.09 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized installer who is trained and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture in accordance with manufacturer's written instructions.
- B. Store underlayment rolls on end, on pallets or other raised surfaces. Do not double-stack rolls.
- C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing Work is not in progress.
- D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.11 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit product installation and related Work to be performed in accordance with manufacturer's written instructions and warranty requirements.
 - 1. Install self-adhering, polymer-modified bitumen sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.12 WARRANTY

- A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Manufacturing defects.

2. Materials Warranty Period: 30 years from date of Substantial Completion, prorated, with first 20 years nonprorated.
 3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 130 mph years from date of Substantial Completion.
 4. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 15 years from date of Substantial Completion.
 5. Workmanship Warranty Period: Two years from date of Substantial Completion.
- B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SOURCE LIMITATIONS

- A. Obtain each type of product from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
- B. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.
- C. Energy Performance, ENERGY STAR: Provide asphalt shingles that are listed on the DOE's "ENERGY STAR Roof Product List" for steep-slope roof products.

2.03 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction; glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
 1. Manufacturers: Basis of Design
 - a. CertainTeed Corporation; Saint-Gobain North America.: Basis of Design "Landmark Pro" Shingle.

2. Butt Edge: Straight
3. Strip Size: Manufacturer's standard
4. Algae Resistance: Granules resist algae discoloration.
5. Color : Colonial Slate as Submitted and Approved by Nantucket Historical Commission

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles

2.04 UNDERLAYMENT MATERIALS

A. Self-Adhering, Polymer-Modified Bitumen Sheet: ASTM D1970/D1970M, minimum 40-mil thick sheet; glass-fiber-mat-reinforced, polymer-modified asphalt; with slip-resistant top surface and release backing; cold applied. Provide primer for adjoining concrete, masonry, and metal surfaces to receive underlayment.

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. Carlisle WIP Products; a brand of Carlisle Construction Materials.
 - b. CertainTeed Corporation; Saint-Gobain North America.
 - c. Henry Company.

2. Top Surface: Granule

2.05 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid-section, high-density, UV-stabilized plastic ridge vent for use under ridge shingles.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Air Vent, Inc.; a Gibraltar Industries company.
 - b. CertainTeed Corporation; Saint-Gobain North America.
 - c. Owens Corning.
2. Minimum Net Free Area: 18 sq inches of net free per lineal foot
3. Width: 12"
4. Thickness: As recommended by manufacturer
5. Features:
 - a. Nonwoven geotextile filter strips.
 - b. External deflector baffles.

2.06 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.
- B. Elastomeric Flashing Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant; of class and use classifications required to seal joints and remain watertight; recommended in writing by manufacturer for installation of flashing systems.
- C. Roofing Nails: ASTM F1667, stainless steel, wire shingle nails, minimum 0.120-inch-diameter, sharp-pointed, with a 3/8- to 7/16-inch- diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through sheathing less than 3/4 inch thick.
 - 1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

2.07 METAL FLASHING AND TRIM

- A. Comply with requirements in Section 07620 SHEET METAL FLASHING AND TRIM.
 - 1. Sheet Metal: Stainless steel
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise specified in this Section or indicated on Drawings.
 - 1. Cricket and Backer Flashings: Fabricate with concealed flange extending a minimum of 18 inches beneath upslope asphalt shingles and 6 inches beyond each side of curb and 6 inches above the roof plane.
 - 2. Drip Edges: Fabricate in lengths not exceeding 10 feet with minimum 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge.
 - 3. Vent-Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches from pipe onto roof.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provisions have been made for flashings and penetrations through asphalt shingles.
 - 3. Verify that vent stacks and other penetrations through roofing are installed and securely fastened.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF UNDERLAYMENT MATERIALS

- A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.
- B. Self-Adhering, Polymer-Modified Bitumen Sheet: Install, wrinkle free, on entire roof deck.
 - 1. Comply with low-temperature installation restrictions of underlayment manufacturer.
 - 2. Install lapped in direction that sheds water.
 - a. Lap sides not less than 4 inches.
 - b. Lap ends not less than 6 inches, staggered 24 inches between succeeding courses.
 - c. Roll laps with roller.
 - 3. Prime concrete, masonry, and metal surfaces to receive self-adhering sheet.
 - 4. Ridges: Install without obstructing continuous ridge vent slot.
 - 5. Other Roof-Penetrating Elements: Extend 18 inches beyond penetrating elements and return vertically against penetrating elements not less than 8 inches.
 - 6. Cover underlayment within seven days.

3.03 INSTALLATION OF METAL FLASHING AND TRIM

- A. Install metal flashings and trim to comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."
 - 1. Install metal flashings in accordance with recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
 - 2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.
- B. Apron Flashings: Extend lower flange over and beyond each side of downslope asphalt shingles and up the vertical surface.
- C. Step Flashings: Install with a headlap of 2 inches and extend over underlying shingle and up the vertical face.
 - 1. Install with lower edge of flashing just upslope of, and concealed by, butt of overlying shingle.
 - 2. Fasten to roof deck only.
- D. Cricket and Backer Flashings: Install against roof-penetrating elements extending concealed flange beneath upslope asphalt shingles and beyond each side.
- E. Counterflashings: Coordinate with installation of base flashing and fit tightly to base flashing. Lap joints a minimum of 4 inches secured in a waterproof manner.
 - 1. Install in reglets or receivers.
- F. Rake Drip Edges: Install over underlayment materials and fasten to roof deck.
- G. Eave Drip Edges: Install below underlayment materials and fasten to roof deck.
- H. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

3.04 INSTALLATION OF ASPHALT SHINGLES

- A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removed with self-sealing strip face up at roof edge.
 - 1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.
 - 2. Install starter strip along rake edge.

- C. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Install first and remaining courses of three-tab-strip asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- E. Fasten asphalt shingle strips with a minimum of six roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.
 - 1. Locate fasteners in accordance with manufacturer's written instructions.
 - 2. Where roof slope exceeds 18:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
 - 3. Where roof slope is less than 4:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
 - 4. When ambient temperature during installation is below 50 deg F, hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
 - 5. Do not nail asphalt shingles within 6 inches of valley center.
- F. Ridge Vents: Install continuous ridge vents over asphalt shingles in accordance with manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- G. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing-shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds.
 - 1. Fasten with roofing nails of sufficient length to penetrate sheathing.
 - 2. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

3.05 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("the work") on the following project:
 - 1. Owner: <Insert name of Owner>.
 - 2. Owner Address: <Insert address>.
 - 3. Building Name/Type: <Insert information>.
 - 4. Building Address: <Insert address>.
 - 5. Area of the Work: <Insert information>.
 - 6. Acceptance Date: <Insert date>.

7. Warranty Period: 5 Years from Date of Acceptance
8. Expiration Date: <Insert date>.

- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant the work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that, during Warranty Period, Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of the work as are necessary to correct faulty and defective work and as are necessary to maintain the work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to the work and other parts of the building, and to building contents, caused by:
 - a. Lightning;
 - b. Peak gust wind speed exceeding 130 mph;
 - c. Fire;
 - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. Faulty construction of copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. Vapor condensation on bottom of roofing; and
 - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 2. When the work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to the work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of the work.
 4. During Warranty Period, if Owner allows alteration of the work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of the alterations, but only to the extent the alterations affect the work covered by this Warranty. If Owner engages Roofing Installer to perform the alterations, Warranty shall not become null and void unless Roofing Installer, before starting the alterations, notified Owner in writing, showing reasonable cause for claim, that the alterations would likely damage or deteriorate the work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a use or service more severe than originally specified, this Warranty shall become null and void on date of the change, but only to the extent the change affects the work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect the work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on the work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of the work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.

1. Authorized Signature: <Insert signature>.
2. Name: <Insert name>.
3. Title: <Insert title>.

END OF SECTION

SECTION 07 42 93

SOFFIT PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Metal soffit panels.

1.03 PREINSTALLATION MEETINGS:

- A. Preinstallation Conference: Conduct conference at Project site

1.04 ACTION SUBMITTALS:

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.05 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.06 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.07 QUALITY ASSURANCE:

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately 150 sq ft as coordinated with other trades for mock-up, by full eave width, including attachments and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.09 FIELD CONDITIONS:

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.010 COORDINATION:

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.011 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Structural failures including rupturing, cracking, or puncturing.
- b. Deterioration of metals and other materials beyond normal weathering.

- 2. Warranty Period: Two years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
- b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

- 1. Wind Loads: As indicated on Drawings.
- 2. Other Design Loads: As indicated on Drawings
- 3. Deflection Limits: For wind loads, no greater than 1/180 the span.

- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces

2.02 METAL SOFFIT PANELS:

- A. Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile Metal Soffit Panels Perforated panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.
 - 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. ATAS International, Inc.
 - b. CENTRIA.
 - c. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
 - 2. Metallic-Coated Steel Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.034 inch min.
 - b. Exterior Finish: Two-coat fluoropolymer
 - c. Color: As selected by Architect from manufacturer's full range

2.03 MISCELLANEOUS MATERIALS:

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.04 FABRICATION:

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.05 FINISHES:

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. 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 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.
- C. Steel Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.

2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
 - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
 1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.03 INSTALLATION:

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
 2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
 3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
 4. Stainless Steel Panels: Use stainless steel fasteners.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- E. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.04 CLEANING AND PROTECTION:

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 46 46

FIBER-CEMENT SIDING

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section includes fiber-cement siding

1.02 ACTION SUBMITTALS:

- A. Product Data: For each type of product.
- B. Samples: For fiber-cement siding including related accessories.

1.03 INFORMATIONAL SUBMITTALS:

- A. Product certificates.
- B. Product test reports.
- C. Research/evaluation reports.
- D. Sample warranty.

1.04 CLOSEOUT SUBMITTALS:

- A. Maintenance data.

1.05 QUALITY ASSURANCE:

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 WARRANTY:

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 FIBER-CEMENT SIDING:

- A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Fiber Cement Corporation.
 - b. James Hardie Building Products, Inc.
 - c. Nichiha Architectural Panels.
- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness: Not less than 5/16-inch.
- D. Shingle / Shakes Pattern: 48-inch- wide, straight-edge notched sheets with wood-grain texture, 6.976" Exposure.
- E. Smooth Panel Texture: 48-inch-wide minimum sheets with smooth texture.
- F. Factory Priming: Manufacturer's standard acrylic primer.

2.02 ACCESSORIES:

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
- B. Flashing: Provide stainless-steel flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
- C. Fasteners:
 1. For fastening to wood, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1-inch into substrate.
 2. For fastening fiber cement, use stainless-steel fasteners.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Install fasteners no more than 24-inches o.c.
- B. Install joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation.

3.02 ADJUSTING AND CLEANING:

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Formed roof-drainage sheet metal fabrications.
 - 2. Formed steep-slope roof sheet metal fabrications.
- B. Related Requirements:
 - 1. Section 07 72 00 "Roof Accessories" for vents, manufactured gutter guards and other manufactured roof accessory units.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following
 - 1. Underlayment materials.
 - 2. Elastomeric sealant.
 - 3. Butyl sealant.
 - 4. Epoxy seam sealer.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details for forming, including profiles, shapes, seams, and dimensions.

5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 6. Include details of termination points and assemblies.
 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 8. Include details of roof-penetration flashing.
 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
 10. Include details of special conditions.
 11. Include details of connections to adjoining work.
 12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.
- D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- E. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
 4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For copings and roof edge flashing, from an agency acceptable to authority having jurisdiction ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.
- E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested shop shall be listed as able to fabricate required details as tested and approved.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Coordinate mock-up with other sections in order to provide the appropriate sheet metal flashing and trim to make a complete assembly for review and confirmation of the mockup.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 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: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
 - 2. Color: As selected by Architect from manufacturer's full range

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 minimum total dry film thickness of 0.5 mil.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 316, dead soft, fully annealed; with smooth, flat surface.
1. Finish: ASTM A480/A480M, No. 4 (polished directional satin)
 - a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1) Run grain of directional finishes with long dimension of each piece.
 - 2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
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. Carlisle WIP Products; a brand of Carlisle Construction Materials.
 - b. Henry Company.
 - c. Owens Corning.
 - d. Protecto Wrap Company.
 2. Source Limitations: Obtain underlayment from single source from single manufacturer.
 3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.
- B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

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

- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Copper, Zinc-Tin Alloy-Coated Copper, Copper-Clad Stainless Steel Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
 - 3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
 - 5. Fasteners for Zinc-Coated (Galvanized), Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
 - 6. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
- H. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

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

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

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

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

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

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
 2. Fabricate in minimum 96-inch- long sections.
 3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness
 4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
 5. Gutter Profile: Style I in accordance with cited sheet metal standard.
 6. Expansion Joints: Butt type with cover plate
 7. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen and Wire-ball downspout strainer
 8. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
 9.
 - a. Aluminum: .063inch thick.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors
1. Manufactured Hanger Style: Fig. 1-34B in accordance with SMACNA's "Architectural Sheet Metal Manual."
 2. Fabricate from the following materials:
 - a. Aluminum: 0.032 inch thick.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
 1. Aluminum: 0.032 inch thick
- B. Drip Edges: Fabricate from the following materials:
 1. Aluminum: 0.032 inch thick.
- C. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
 1. Aluminum: 0.032 inch thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 1. Aluminum: 0.032 inch thick.
- E. Flashing Receivers: Fabricate from the following materials:
 1. Aluminum: 0.032 inch thick.
- F. Roof-Penetration Flashing: Fabricate from the following materials:
 1. Stainless Steel: 0.0188 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.0188 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering, High-Temperature Sheet Underlayment:
 - 1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
 - 2. Prime substrate if recommended by underlayment manufacturer.
 - 3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
 - 4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
 - 5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
 - 6. Roll laps and edges with roller.
 - 7. Cover underlayment within 14 days.
- B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
 - 1. Install in shingle fashion to shed water.
 - 2. Lapp joints not less than 4 inches.

3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and/or sealant as occurs.
 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
 6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 8. Do not field cut sheet metal flashing and trim by torch.
 9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.

- a. Embed hooked flanges of joint members not less than 1 inch into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
- 1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
 - 2. Do not solder metallic-coated steel and aluminum sheet.
 - 3. Do not pretin zinc-tin alloy-coated copper.
 - 4. Do not use torches for soldering.
 - 5. Heat surfaces to receive solder, and flow solder into joint.
 - a. Fill joint completely.
 - b. Completely remove flux and spatter from exposed surfaces.
 - 6. Stainless Steel Soldering:
 - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
 - b. Promptly remove acid-flux residue from metal after tinning and soldering.
 - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 - 7. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
 - 8. Copper-Clad Stainless Steel Soldering: Tin edges of uncoated sheets, using solder for copper-clad stainless steel.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
 - 1. Join sections with joints sealed with sealant.
 - 2. Provide for thermal expansion.
 - 3. Attach gutters at eave or fascia to firmly anchor them in position.
 - 4. Provide end closures and seal watertight with sealant.
 - 5. Slope to downspouts.
 - 6. Fasten gutter spacers to front and back of gutter.

7. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.
8. Anchor gutter with gutter brackets spaced not more than 30 inches apart to roof deck / fascia board unless otherwise indicated, and loosely lock to front gutter bead.
9. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.
10. Install continuous gutter screens on gutters with noncorrosive fasteners.

C. Downspouts:

1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

3.5 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

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

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of anchor and washer spaced at 12 inches o.c. along perimeter and 6 inches o.c. at corners areas unless otherwise indicated.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.
- C. Reglets: Installation of reglets is specified in Section 033000 "Cast-in-Place Concrete." And Section 042000 "Unit Masonry."

3.7 INSTALLATION OF MISCELLANEOUS FLASHING

- A. Equipment Support Flashing:
 - 1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
 - 2. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans:
 - 1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
 - 2. Pipe and install drain line to plumbing waste or drainage system.

3.8 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.10 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 07 71 00
ROOF SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Reglets and counterflashings.

B. Related Requirements:

1. Section 07 31 13 "Asphalt Shingle Roof"
2. Section 07 62 00 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
3. Section 07 72 00 "Roof Accessories" for vents, manufactured gutter guards and other manufactured roof accessory units.
4. Section 07 92 00 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For roof specialties.
 - 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
 - 2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
 - 3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
 - 4. Detail termination points and assemblies, including fixed points.
 - 5. Include details of special conditions.
- C. Samples: For each type of roof specialty and for each color and texture specified.
- D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.
- E. Samples for Verification:
 - 1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
 - 2. Include copings, roof-edge specialties, roof-edge drainage systems made from 12-inch lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of roof specialty.
- C. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.06 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.
- B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 07 31 13 - Asphalt Shingle Roof.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.08 FIELD CONDITIONS

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.09 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 07 31 13 - Asphalt Shingle Roof.
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to 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. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. FM Approvals' Listing: Manufacture and install copings, roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.
- C. SPRI Wind Design Standard: Manufacture and install copings, roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings

D. 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 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.

B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

E. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

2.03 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. 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. ATAS International, Inc.
- b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
- c. Henry Company.
- d. Owens Corning.
- e. Polyglass U.S.A., Inc.
- f. Protecto Wrap Company.

2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F.

3. 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.

2.04 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.
 - 3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
 - 4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
- B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane, silicone 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.

2.05 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Coil-Coated Galvanized-Steel Sheet Finishes:
 - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A755/A755M and coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- E. 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. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions
- F. Aluminum Extrusion 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. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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, roof-edge specialties, and reglets and counterflashings.
 - 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.

3.03 INSTALLATION, GENERAL

- A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
 - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
 - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
 - 4. Torch cutting of roof specialties is not permitted.
 - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum and stainless steel 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.
- 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.
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.04 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

- A. Coordinate installation of reglets and counterflashings with installation of base flashings.

- B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.
- C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

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. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 71 00

SECTION 07 72 00

ROOF ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

- 1. Pipe portals.
- 2. Preformed flashing sleeves.

- B. Related Requirements:

- 1. Section 07 62 00 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, , and miscellaneous sheet metal trim and accessories.
- 2. Section 07 71 00 "Roof Specialties" for manufactured fasciae, and counterflashing.

1.03 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For roof accessories.

- 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.
- D. Delegated-Design Submittal: For roof curbs and equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
 - 2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
 - 4. Required clearances.
- B. Sample Warranties: For manufacturer's special warranties.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.07 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 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 according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to 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. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Wind-Restraint Performance: As indicated on Drawings

2.02 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and perforated metal collar.
 - 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. Custom Solution Roof and Metal Products.
 - b. Menzies Metal Products.
 - c. Thaler Metal Industries Ltd.
 - 2. Metal: Aluminum sheet, 0.063 inch thick.
 - 3. Diameter: As indicated on Drawings on MEP Drawings
 - 4. Finish: Manufacturer's standard
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
 - 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. Custom Solution Roof and Metal Products.
 - b. Menzies Metal Products.
 - c. Milcor; a division of Hart & Cooley, Inc.
 - 2. Metal: Aluminum sheet, 0.063 inch thick
 - 3. Height: 13 inches
 - 4. Diameter: As indicated on MEP Drawings
 - 5. Finish: Manufacturer's standard

2.03 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation

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.
 - B. 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.
 - C. Aluminum Sheet: ASTM B209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
 1. 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.
 - D. 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.
 - E. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.
 - F. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.
 - G. Steel Tube: ASTM A500/A500M, round tube.
 - H. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.
 - I. Steel Pipe: ASTM A53/A53M, galvanized.
- 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. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

- C. 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 AWWA C2; not less than 1-1/2 inches thick.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. 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.
- F. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - 1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- G. 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.
- H. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- I. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- J. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.05 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. 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 and stainless steel 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.
 - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

3.03 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 Manufacturer written instructions.
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Mildew-resistant joint sealants.
6. Latex joint sealants.

B. Related Requirements:

1. Section 07 62 00- SHEET METAL FLASHING AND TRIM: Sealant integral with flashings.

1.02 PREINSTALLATION MEETINGS

- ###### A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- ###### A. Product Data: For each joint-sealant product.

- ###### B. Samples: For each kind and color of joint sealant required.

- ###### C. 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.

1.04 INFORMATIONAL SUBMITTALS

- ###### A. Product test reports.

- B. Preconstruction laboratory test reports.
- C. Preconstruction field-adhesion-test reports.
- D. Field-adhesion-test reports.
- E. Sample warranties.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.06 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

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.

PART 2 - PRODUCTS

2.01 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealant As selected by Architect from manufacturer's full range.

2.02 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.

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

- a. GE Construction Sealants; Momentive Performance Materials Inc.

- 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.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. GE Construction Sealants; Momentive Performance Materials Inc.
- b. Pecora Corporation.
- c. Sika Corporation; Joint Sealants.

- 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.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. GE Construction Sealants; Momentive Performance Materials Inc.
- b. The Dow Chemical Company.

- 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.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Pecora Corporation.
 - c. The Dow Chemical Company.

- E. 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sika Corporation; Joint Sealants.
 - c. The Dow Chemical Company.

- F. 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Soudal USA.
 - b. The Dow Chemical Company.

- G. 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - b. Pecora Corporation.
 - c. Sika Corporation; Joint Sealants.

- H. 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - b. Pecora Corporation.
 - c. Sika Corporation; Joint Sealants.

- I. 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
- J. 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - b. Sika Corporation; Joint Sealants.

2.03 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sika Corporation; Joint Sealants.
 - c. Tremco Incorporated.
- C. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sika Corporation; Joint Sealants.
 - c. The Dow Chemical Company.
- D. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, 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.

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

a. The Dow Chemical Company.

E. Silicone, Nonstaining, M, NS, 50, NT: Nonstaining, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.

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

a. Tremco Incorporated.

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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pecora Corporation.

b. Sika Corporation; Joint Sealants.

c. Tremco Incorporated.

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.

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

a. Sika Corporation; Joint Sealants.

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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Corporation.

b. LymTal International Inc.

- 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.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Bostik, Inc.
- 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.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Pecora Corporation.
 - c. Permathane®/Acryl-R®; ITW Polymers Sealants North America.
- 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.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Pecora Corporation.
- 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.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Sherwin-Williams Company (The).
- 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.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Tremco Incorporated.

- 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Pecora Corporation.
 - c. Sika Corporation; Joint Sealants.

- 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. LymTal International Inc.

- 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Pecora Corporation.
 - c. Sika Corporation; Joint Sealants.

2.05 IMMERSIBLE JOINT SEALANTS

- A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C1247, Class 1, tested in deionized water unless otherwise indicated

- B. Urethane, Immersible, S, NS, 100/50, NT, I: Immersible, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses NT, and I.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Tremco Incorporated.

- C. Urethane, Immersible, S, NS, 35, NT, I: Immersible, single-component, nonsag, plus 35 percent and minus 35 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT and I.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. BASF Corporation.

- D. Urethane, Immersible, S, NS, 50, T, NT, I: Immersible, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T, NT, and I.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Tremco Incorporated.

- E. Urethane, Immersible, S, NS, 35, T, NT, I: Immersible, single-component, nonsag, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 35, Uses T, NT, and I.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Sika Corporation; Joint Sealants.

- F. Urethane, Immersible, S, NS, 25, T, NT, I: Immersible, 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, NT, and I.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Pecora Corporation.
 - c. Tremco Incorporated.

- G. Urethane, Immersible, S, P, 50, T, NT, I: Immersible, single-component, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 50, Uses T, NT, and I.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Tremco Incorporated.

- H. Urethane, Immersible, S, P, 25, T, NT, I: Immersible, 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, NT, and I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sika Corporation; Joint Sealants.
 - b. Tremco Incorporated.
 - c. W.R. Meadows, Inc.
- I. Urethane, Immersible, M, NS, 50, T, NT, I: Immersible, 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, NT, and I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. LymTal International Inc.
 - b. Tremco Incorporated.
- J. Urethane, Immersible, M, NS, 25, T, NT, I: Immersible, 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, NT, and I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Sika Corporation; Joint Sealants.
- K. Urethane, Immersible, M, P, 25, T, NT, I: Immersible, 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, NT, and I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. LymTal International Inc.
 - c. Sika Corporation; Joint Sealants.

2.06 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. The Dow Chemical Company.
 - c. Tremco Incorporated.
- C. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sherwin-Williams Company (The).
 - c. Tremco Incorporated.

2.07 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alcot Plastics Ltd.
 - b. BASF Corporation.
 - c. Construction Foam Products; a division of Nomaco, Inc.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.08 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.

- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 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 laitance and form-release agents from concrete.
 - 2. 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.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.02 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. 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.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration

indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.03 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.04 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces: JS-A.

1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between plant-precaster architectural concrete paving units.
 - c. Tile control and expansion joints.
 - d. Joints between different materials listed above.
 - e. Other joints as indicated on Drawings.
2. Joint Sealant: Urethane, M, P, 50, T, NT
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors

B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion: JS-B

1. Joint Locations:
 - a. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, immersible, S, P, 25, T, NT, I
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces: JS- C
1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precaster architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces: JS-D
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, P, 25, T, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces: JS-E.
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry, concrete walls and partitions.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors

F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement: JS-F.

1. Joint Locations:

- a. Control joints on exposed interior surfaces of exterior walls.
- b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
- c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors

G. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces: JS-G.

1. Joint Locations:

- a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
- b. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors

H. Joint-Sealant Application: Concealed mastics: JS-H.

1. Joint Locations:

- a. Aluminum thresholds.
- b. Sill plates.
- c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section includes access doors and frames for walls and ceilings.
- B. Related Requirements:
 - 1. Section 04 20 00, UNIT MASONRY: Installation of access panels into masonry assemblies.
 - 2. Division 22- PLUMBING
 - 3. Division 23- HVAC
 - 4. Division 26- ELECTRICAL

1.02 ACTION SUBMITTALS:

- A. Product Data: For each type of product.
- B. Samples: For each type of access door and frame and for each finish specified.
- C. Product Schedule: For access doors and frames.

1.03 CLOSEOUT SUBMITTALS:

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.04 QUALITY ASSURANCE:

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

2.02 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Larsens Manufacturing Company.
2. Description: Face of door flush with frame; with concealed flange for installation and concealed hinge.
3. Locations: Wall and ceiling
4. Stainless Steel Sheet for Door: Nominal 0.062-inch, 16 gage, ASTM A480/A480M No. 4 finish.
5. Frame Material: Same material and thickness as door
6. Latch and Lock: Cam latch, screwdriver operated

B. Fire-Rated, Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Maxam Metal Products Limited.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for installation, self-closing door, and concealed hinge.
3. Locations: Wall and ceiling
4. Fire-Resistance Rating: Not less than that of adjacent construction indicated on drawings.
5. Temperature-Rise Rating: 450 deg F at the end of 30 minutes.
6. Stainless Steel Sheet for Door: Nominal 0.038 inch, 20 gage, ASTM A480/A480M No. 4 finish.
7. Frame Material: Same material, thickness, and finish as door
8. Latch and Lock: Self-closing, self-latching door hardware, Cam latch, screwdriver operated

2.03 MATERIALS:

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304]. Remove tool and die marks and stretch lines, or blend into finish.

- E. Stainless Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- F. Frame Anchors: Same material as door face.
- G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.04 FABRICATION:

- A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

2.05 FINISHES:

- A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Adjust doors and hardware, after installation, for proper operation.

3.02 FIELD QUALITY CONTROL:

- A. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, section 5.2.
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- D. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80.

END OF SECTION

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ACCESS DOORS AND FRAMES

SECTION 08 34 83

FLOOR DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Aluminum floor doors.

1.03 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Product Schedule: For floor doors. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.01 ALUMINUM FLOOR DOORS

- A. Flush Cover Aluminum Floor Door:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. EJ
 - 2. Bilco
 - 3. Babcock Davis
- C. Frame: Mill finish 6061-T6 aluminum, angle profile. Maximum frame height of 4.5 inches.
- D. Door: Single leaf; 1/4-inch-thick 5086 aluminum diamond plate finish minimum.

- E. Loading Capacity: H-20 Wheel Loading.
- F. Hardware:
 - a. Material and Finish: Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
 - b. Hinges: Heavy-duty butt hinges with stainless steel pins.
 - c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
 - d. Latch: Stainless steel slam latch.
 - e. Lock: Latch with removable handle
- G. Safety Accessories: Fall through protection.

2.02 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- E. Rolled-Stainless Steel Floor Plate: ASTM A793, manufacturer's standard finish.
- F. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666. Remove tool and die marks and stretch lines, or blend into finish.
- G. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- H. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

- I. Aluminum Sheet: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- J. Frame Anchors: Same material as door face.
- K. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.03 FABRICATION

- A. General: Provide floor doors manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure floor doors to types of supports indicated.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder locks, furnish two keys per lock and key all locks alike.
 - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.
- E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that comes in contact with concrete.

2.04 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

- E. Prime Painted Steel: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- F. Stainless Steel Finish: Bright, cold-rolled, unpolished ASTM A480/A480M No. 2B finish.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for installing floor doors.
- B. Waterproofing shall be installed between cast-in-place concrete and existing manhole riser, as indicated on drawings and per specification section 03 15 13.
- C. Hatch shall be installed so that final pavement grade is flush with the cover and top of curb.

3.03 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.04 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 34 83

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

A. Section Includes

- 1. Furnishing and installation of all mechanical and electrical finish hardware necessary for all doors, and hardware as specified herein and as enumerated in hardware sets and as indicated and required by actual conditions at the building. The hardware shall include the furnishing of all necessary screws, bolts, expansion shields, drop plates, and all other devices necessary for the proper application of the hardware.

B. Related Sections

- 1. Division 6 Section - Finish Carpentry
- 2. Division 8 Section – AF Composite Doors
- 3. Division 26 Section - Electrical

- C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:

- 1. Signage, except as noted.

1.03 REFERENCES:

- A. Applicable state and local building codes and standards.

B. FIRE/LIFE SAFETY

- 1. NFPA - National Fire Protection Association
 - a. NFPA 70 – National Electric Code
 - b. NFPA 80 - Standard for Fire Doors and Fire Windows
 - c. NFPA 101 - Life Safety Code
 - d. NFPA 105 - Smoke and Draft Control Door Assemblies

C. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

D. Accessibility

1. ADA - Americans with Disabilities Act.

E. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware

F. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

1.04 SUBMITTALS:

- A. Catalog Cuts: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- B. Final Hardware Schedule Content: Submit schedule with hardware sets in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, Include the following information:
 1. Door Index; include door number, heading number, and Architects hardware set number.
 2. Opening Lock Function Spreadsheet; list locking device and function for each opening.
 3. Type, style, function, size, and finish of each hardware item.
 4. Name and manufacturer of each item.
 5. Fastenings and other pertinent information.
 6. Location of each hardware set cross-referenced to indications on Drawings.

7. Explanation of all abbreviations, symbols, and codes contained in schedule.
 8. Mounting locations for hardware.
 9. Door and frame sizes and materials.
 10. Name and phone number for the local manufacturer's representative for each product.
 11. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and/or access control components). Operational description should include how the door will operate on egress, ingress, and/or fire/smoke alarm connection.
- C. Key Schedule: After a keying meeting between representatives of the Owner, Architect, hardware supplier, and, if requested, the representative for the lock manufacturer, provide a keying schedule, listing the levels of keying, as well as an explanation of the key system's function, the key symbols used, and the door numbers controlled. Utilize ANSI A156.28 "Recommended Practices for Keying Systems" as a guideline for nomenclature, definitions, and approach for selecting the optimal keying system.
- D. Samples: If requested by the Architect, submit production sample or sample installations as requested of each type of exposed hardware unit in the finish indicated, and tagged with a full description for coordination with the schedule.
1. Samples will be returned to the supplier in like-new condition. Units that are acceptable to the Architect may, after final check of operations, be incorporated into the Work, within limitations of key coordination requirements.
- E. Templates: After final approval of the hardware schedule, provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware.
- F. Operations and Maintenance Data: Provide in accordance with Division 1 and include the following:
1. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 2. Catalog pages for each product.
 3. Name, address, and phone number of local representative for each manufacturer.
 4. Parts list for each product.
 5. Copy of final approved hardware schedule, edited to reflect "As installed."

6. Copy of final keying schedule.
 7. One (1) complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
 8. Copy of warranties including appropriate reference numbers for manufacturers to identify the project.
- G. Certificates of Compliance: Upon request of Architect or Authority Having Jurisdiction certificates of compliance for fire-rated hardware and installation instructions shall be made available.
- 1.05 QUALITY ASSURANCE:
- A. Substitutions: Products are to be those specified to ensure a uniform basis of acceptable materials. Requests for substitutions must be made in accordance with Division 1 requirements. If proposing a substitute product, submit product data for the proposed item with product data for the specified item and indicate basis for substitution and savings to be made. Provide sample if requested. Certain products have been selected for their unique characteristics and particular project suitability.
 - B. Supplier Qualifications: A recognized architectural hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides a certified Architectural Hardware Consultant (AHC) available to the Owner, Architect, and Contractor, at reasonable times during the course of the Work for consultation.
 - C. Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, exit devices, closers, etc.) from a single manufacturer.
 - D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwrites Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to the authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.
- 1.06 DELIVERY, STORAGE, AND HANDLING:
- A. Tag each item or package separately with identification related to the final hardware schedule, and include installation instructions with each item or package.
 - B. Each article of hardware shall be individually packaged in manufacturer's original packaging.

- C. Contractor will provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Items damaged in shipment shall be replaced promptly and with proper material and paid for by whomever did the damage or caused the damage to occur.
- E. Hardware shall be handled in a manner to avoid damage, marring, or scratching. Irregularities that occur to the hardware after it has been delivered to the Project shall be corrected, replaced, or repaired by the Contractor. Hardware shall be protected against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. No direct shipments will be allowed unless approved by the Contractor.

1.07 WARRANTY:

- A. Provide manufacturer's warranties as specified in Division 1 and as follows:
 - 1. Closers: 30 years, except electronic closers, 2 years.
 - 2. Exit Devices: 3 years, except electrified devices, 1 year.
 - 3. Locksets: 3 years, except electrified locksets, 1 year.
 - 4. Other hardware: 1 year.
- B. No liability is to be assumed where damage or faulty operation is due to improper installation, improper use, or abuse.
- C. Products judged to be defective during the warranty period shall be replaced or repaired in accordance with the manufacturer's warranty, at no additional cost to the Owner.

1.08 MAINTENANCE:

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. The Awarding Authority has determined that certain products should be selected for their unique characteristics and particular project suitability to ensure expected performance and maintenance standards. After investigating available product offerings, the
- B. Approval of manufacturers other than those listed shall be in accordance with paragraph 1.05.A.

- C. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- D. Where the hardware specified is not adaptable to the finished shape or size of the members requiring hardware, furnish suitable types having the same operation and quality as the type specified, subject to the Architect's approval.

2.02 MATERIALS:

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent that no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Review door specification and advise Architect if thru-bolts are required.
4. Hardware shall be installed with the fasteners provided by the hardware manufacturer.

B. Hinges

1. Provide continuous, ball bearing hinges.
2. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins

C. Flush Bolts

1. Provide automatic and manual flush bolts with forged bronze face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12-inch steel or brass rods at doors up to 90-inches in height. Top rods at manual flush bolts for

doors over 90-inches in height shall be increased by 6-inches for each additional 6-inches of door height. Provide dust-proof strikes at each bottom flush bolt.

2. Acceptable manufacturers and/or products: Ives, Burns, Rockwood.

D. Coordinators

1. Provide a bar-type coordinating device, surface applied to the underside of the stop at the frame head where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors.
2. Provide a filler bar of the correct length for the unit to span the entire width of the opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

E. Mortise Locks

1. Provide mortise locks certified as ANSI A156.13, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Lock case shall be multi-function and field reversible for handing without opening the case. Cylinders: Refer to 2.04 KEYING.
2. Provide locks with a standard 2-3/4-inches backset with a full 3/4-inch throw stainless steel mechanical anti-friction latchbolt. Deadbolt shall be a full 1-inch throw, constructed of stainless steel.
3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
4. Lever trim shall be solid brass, bronze, or stainless steel, cast or forged in the design specified, with wrought roses and external lever spring cages. Levers shall be thru-bolted to assure proper alignment, and shall have a 2-piece spindle.
 - a. Lever design shall be Best 07A or submitted product equivalent.
 - b. Lever trim on the secure side of doors serving rooms considered by the authority having jurisdiction to be hazardous shall have a tactile warning.

F. Exit Devices

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit and/or Fire Exit Hardware. Cylinders: Refer to 2.04 KEYING.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to the standard architectural finishes to match the balance of the door hardware.

3. Exit devices shall incorporate a fluid damper or other device that eliminates noise associated with exit device operation. Touchpad shall extend a minimum of one half of the door width, but not the full length of the exit device rail. End-cap will have two-point attachment to door. Only compression springs will be used in devices, latches, and outside trims or controls.
4. Devices to incorporate a deadlatching feature for security and/or for future addition of alarm kits and/or other electrical requirements.
5. Vertical rod devices shall be capable of being field modified to less bottom rod devices by removal of bottom rod and adding firing pin(s), if required at fire rated openings.
6. Provide manufacturer's standard strikes.
7. Provide exit devices cut to door width and height. Locate exit devices at a height recommended by the exit device manufacturer, allowable by governing building codes, and approved by the Architect.
8. Mechanism case shall sit flush on the face of all flush doors, or spacers shall be furnished to fill gaps behind devices. Where glass trim or molding projects off the face of the door, provide glass bead kits.
9. Non-fire-rated exit devices shall have cylinder dogging.
10. Removable mullions shall be a 2-inches x 3-inches steel tube. Where scheduled, mullion shall be of a type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
11. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to a 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever style will match the lever style of the locksets.
 - b. Lever trim on doors serving rooms considered by the authority having jurisdiction to be hazardous shall have a tactile warning.
12. Exit devices for fire rated openings shall be UL labeled fire exit hardware.
13. Field drill weep holes per manufacturer's recommendation for exit devices used in full exterior application, highly corrosive areas, and where noted in the hardware sets.

G. Roller Latches

1. Provide roller latches with a 4-7/8-inches strike at single doors to fit ANSI frame prep. If dummy levers are used in conjunction with roller latch mount the roller

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DOOR HARDWARE

latch at a height as to not interfere with the proper mounting and height of the dummy lever.

2. Provide roller latches 2-1/4-inches full lip strike at pair doors. Mount roller in the top rail of each leaf per manufacturer's template.

H. Door Closers

1. Provide door closers certified to ANSI/BHMA A156.4 Grade 1 requirements by a BHMA certified independent testing laboratory. Surface mounted mechanical closers shall be certified to exceed ten million (10,000,000) full load cycles by a recognized independent testing laboratory. Closers shall be ISO 9000 certified. Units shall be stamped with date of manufacture code.
2. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder, and shall utilize full complement bearings at shaft. Cylinder body shall be 1-1/2-inch diameter, and double heat-treated pinion journal shall be 11/16-inch diameter.
3. Provide hydraulic fluid requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F. Fluid shall be fireproof and shall pass the requirements of the UL10C "positive pressure" fire test.
4. Spring power shall be continuously adjustable over the full range of closer sizes and allow for reduced opening force as required by accessibility codes and standards. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and backcheck.
5. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within a 6-inch top rail without the use of a mounting plate so that closer shall not be visible through vision panel from pull side.
6. Closers shall not incorporate Pressure Relief Valve (PRV) technology.
7. Closer cylinders, arms, adapter plates, and metal covers shall have a powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or shall have special rust inhibitor (SRI).
8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other finish hardware items interfering with closer mounting.

9. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

I. Door Trim

1. Provide push plates 4-inches wide x 16-inches high x 0.050-inch thick and beveled 4 edges. Where width of door stile prevents use of 4-inches wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Push bars shall be of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.

J. Protection Plates

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch thick as scheduled. Furnish with machine or wood screws, finished to match plates. Sizes of plates shall be as follows:
 - a. Kick Plates – 10-inches high x 2-inches less width of door on single doors, 1-inch less width of door on pairs

K. Overhead Stops and Overhead Stop/holders

1. Provide heavy duty concealed mounted overhead stop or overhead stop/holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy or medium duty and concealed or surface mounted overhead stop or overhead stop/holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking a wall, open against equipment, casework, sidelights, and/or where conditions do not allow a wall stop or a floor stop presents a tripping hazard.
3. Where overhead holders are specified provide friction type at doors without a closer and positive type at doors with a closer.

L. Door Stops and Holders

1. Provide door stops for all doors in accordance with the following requirements:

- a. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
- b. Where wall stops cannot be used, provide dome type floor stops of the proper height.
- c. At any opening where a wall or floor stop cannot be used, a medium duty surface mounted overhead stop shall be used.

M. Thresholds, Seals, Door Sweeps, Automatic Door Bottoms, and Gasketing

1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items as closely as possible.
2. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

N. Silencers

1. Provide "Push-in" type silencers for each hollow metal or wood frame. Provide three for each single frame and two for each pair frame. Omit where gasketing is specified or required by code.

2.03 KEYING

A. Provide cores and cylinders to the following requirements:

1. Provide permanent cores and cylinders keyed by the manufacturer or authorized distributor approved by the Owner. Provide owner with a copy of the bitting list, return receipt requested.
2. The hardware supplier, accompanied by a qualified factory representative for the manufacturer of the cores and cylinders, shall meet with Owner and Architect to review keying requirements and lock functions prior to ordering finish hardware. Submit a keying schedule to Architect for approval.
3. Provide keys as follows
 - a. Ten master keys for each set.
 - b. Three keys per core and/or cylinder.
 - c. Two construction core control keys
 - d. Two permanent core control keys
 - e. Six construction master keys for each type (Contractor is to provide one set of construction keys to Architect)
4. Visual key control:
 - a. Keys shall be stamped with their respective key set number and stamped "DO NOT DUPLICATE".

- b. All keys shall be stamped with their respective key set letters.
 - c. Do not stamp any keys with the factory key change number.
 - d. Do not stamp any cores with key set on face (front) of Core. Stamp on back or side of cores so not to be visible when core is in cylinder.
5. Deliver all keys and/or key blanks from the factory or authorized distributor directly to the Owner in sealed containers, return receipt requested. Failure to comply with these requirements may be cause to require replacement of all or any part of the keying system that was compromised at no additional cost to the Owner.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Prior to installation of any hardware, examine all doors, frames, walls and related items for conditions that would prevent proper installation of finish hardware. Correct all defects prior to proceeding with installation.

3.02 INSTALLATION:

- A. Coordination:

- 1. Prior to installation of hardware, schedule and hold a meeting for the purpose of instructing installers on proper installation and adjustment of finish hardware. Representatives of locks, exit devices, closers, automatic operators, and electrified hardware shall conduct training; provide at least 10 days' notice to representatives. After training a letter of compliance, indicating when the training was held and who was in attendance, shall be sent to the Architect.
- 2. Prior to ordering electrified hardware, schedule and hold a meeting for the purpose of coordinating finish hardware with security, electrical, doors and frames, and other related suppliers. A representative of the supplier of finish hardware, and doors and frames, the electrical subcontractor, and the Owner's security contractor shall meet with the Owner, Architect, and General Contractor prior to ordering finish hardware. After meeting a letter of compliance, indicating when the training was held and who was in attendance, shall be sent to the Architect.

- B. Hardware will be installed by qualified tradesmen, skilled in the application of commercial grade hardware. For technical assistance if necessary, installers may contact the manufacturer's rep for the item in question, as listed in the hardware schedule.
- C. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
- D. Install each hardware item in compliance with the manufacturer's instructions and recommendations, using only the fasteners provided by the manufacturer.

- E. Do not install surface mounted items until finishes have been completed on the substrate. Protect all installed hardware during painting.
- F. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- G. Operating parts shall move freely and smoothly without binding, sticking, or excessive clearance.
- H. Wire (including low voltage), conduit, junction boxes, and pulling of wire is by Division 26, Electrical. Electrical Contractor shall connect wire to door position switches and run wire to central room or area as directed by the Architect. Wires shall be tested and labeled with the Architects opening number. Connections to/from power supplies to electrified hardware and any connection to fire/smoke alarm system, and/or smoke evacuation system where specified is by Division 26 Electrical.

3.03 ADJUSTING, CLEANING, AND DEMONSTRATING:

- A. Adjust and check each operating item of hardware and each door, to insure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.
- B. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make a final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- C. Clean adjacent surfaces soiled by hardware installation.
- D. Instruct Owner's personnel in the proper adjustment, lubrication, and maintenance of door hardware and hardware finishes.

3.04 FIELD QUALITY CONTROL:

- A. Prior to Substantial Completion, the installer, accompanied by representatives of the manufacturers of locks, exit devices, closer, and any electrified hardware, shall perform the following work:
 - 1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
 - 2. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures.
 - 3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.

4. Prepare a written report of current and predictable problems of substantial nature in the performance of the hardware.
5. At completion of project, a qualified factory representative for the manufacturers of locksets, closer, exit devices, and access control products shall arrange and hold a training session to instruct the Owner's personnel on the proper maintenance, adjustment, and/or operation of their respective products. After training a letter of compliance, indicating when the training was held and who was in attendance, shall be sent to the Architect.

3.05 PROTECTION:

- A. Provide for the proper protection of complete items of hardware until the Owner accepts the project as complete. Damaged or disfigured hardware shall be replaced or repaired by the responsible party.

3.06 HARDWARE SCHEDULE:

- A. Provide hardware for each door to comply with requirements of Section "Finish Hardware," hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.
- B. It is intended that the following schedule includes complete items of finish hardware necessary to complete the work. If a discrepancy is found in the schedule, such as a missing item, improper hardware for a frame, door or fire codes, the preamble will be the deciding document.
- C. Locksets, exit devices, and other hardware items are referenced in the Hardware Sets for series, type, and function. Refer to the preamble for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets

HEADING # 01 - (PAIR - STAINLESS STEEL - WITH STOREROOM LOCKSET X FLUSH BOLTS X CLOSER AT ACTIVE LEAF X GASKETING)

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONTINUOUS HINGE	224HD	US28	IVE
1	EA	PANIC HARDWARE	9949-EO	US26D-AM	VON
1	EA	PANIC HARDWARE	9949-L-NL-	US26D-AM	VON
1	EA	MORTISE CYLINDER	AS REQUIRED	626	SCH
1	EA	RIM CYLINDER	AS REQUIRED	626	SCH
2	EA	OFFSET DOOR PULL	8190-0	626	IVE
1	EA	SURFACE CLOSER W/ HOLD OPEN	4111 HEDA W/ 4110-3049CNS	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	STOP	WS407/FS436 AS SPECIFIED	626	IVE
1	SET	ASTRAGAL	551	SS 304	NAT G
1	EA	GASKETING	488S	BK	ZER
1	EA	DRIP CAP	142A	A	ZER
2	EA	DOOR SWEEP	39	A	ZER
1	EA	THRESHOLD	545/547/548 (VERIFY JAMB DEPTH)	A	ZER

OPERATIONAL DESCRIPTION:

IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY.

HEADING # 02 - (SINGLE - STAINLESS STEEL - WITH CLASSROOM LOCKSET X CLOSER X GASKETING)

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONTINUOUS HINGE	224HD	US28	IVE
1	EA	PANIC HARDWARE	CD-99-EO	US26D-AM	VON
1	EA	MORTISE CYLINDER	AS REQUIRED	626	SCH
1	EA	OFSET DOOR PULL	8190-0	626	IVE
1	EA	SURFACE CLOSER W/ HOLD OPEN	4111 HEDA W/ 4110-3049CNS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	626	IVE
1	EA	DRIP CAP **	142A	A	ZER
1	EA	GASKETING **	488S	BK	ZER
1	EA	DOOR SWEEP **	39	A	ZER
1	EA	THRESHOLD **	545/547/548 (VERIFY JAMB DEPTH)	A	ZER

** DRIP CAP / THRESHOLD / GASKETING / DOOR STOP IS NOT REQUIRED AT INTERIOR ELECTRICAL DOOR, "G04A".

OPERATIONAL DESCRIPTION:

IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY.

HEADING # 03 - (SINGLE WITH STOREROOM LOCKSET)

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONTINUOUS HINGE	224HD	US28	IVE
1	EA	STOREROOM LOCK	45H-7D 15R	626	BES
1	EA	SURFACE CLOSER W/ HOLD OPEN	4111 HEDA W/ 4110-3049CNS		
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	STOP	WS407/FS436 AS SPECIFIED	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

OPERATIONAL DESCRIPTION:

IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY.

HEADING # 04 - (SINGLE WITH PRIVACY INDICATOR SET X CLOSER)

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONTINUOUS HINGE	224HD	US28	IVE
1	EA	PRIVACY SET W/ OCCUPANCY INDICATOR	L9040 1583-363 1283-722	626	SCH
1	EA	SURFACE CLOSER	4011 REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

OPERATIONAL DESCRIPTION:

IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY.

END OF SECTION

SECTION 08 83 40

FIBERGLASS-REINFORCED PLASTIC DOORS AND FRAMES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install doors and frames as shown and specified.
2. The extent of doors and frames Work is shown on the Drawings.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed or demolished in association with the doors and frames.

C. Related Sections:

1. Section 06 10 00, Rough Carpentry.
2. Section 07 92 00, Joint Sealants.
3. Section 08 71 00, Door Hardware.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. ANSI A115, Specifications for Door and Frame Preparations for Hardware.
2. ASTM A 103, Zinc (hot-galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
3. ASTM A 123, Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
4. ASTM B 509, Cellular Elastomeric Preformed Gasket and Sealing Material.
5. ASTM D 2000, Classification for Elastomeric Materials for Automotive Applications.
6. Underwriters laboratories, Inc. "Standard for Fire Test of Doors, UL10B".
7. ASTM D 635, Standard Test Method for Rate of Burning or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
8. ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials.

9. ASTM D 2287, Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.
 10. NAAMM, Entrance Manual.
 11. Laminate properties:
 - a. ASTM D 882 Tensile strength.
 - b. ASTM D 790 Flexural strength.
 - c. ASTM D 2583 Barcol Hardness.
 - d. ASTM D 256 Impact resistance.
 - e. ASTM D 792 Density/specific gravity of laminate.
 12. Core Properties:
 - a. ASTM C 177 Thermail properties.
 - b. ASTM D 1622 Density/specific gravity.
 - c. ASTM D E 84 Surface burning characteristics.
- B. Manufacturer Qualifications: Provide doors and frames manufactured by a single firm specializing in the production of this type of Work.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
1. Product Data: Manufacturer's printed product data indicating characteristics of products specified in this Section.
 2. Plans: Indicate location of each door opening assembly in project.
 3. Elevations: Dimensioned elevation of each type door opening assembly in project; indicate sizes and locations of door hardware, and lites and louvers, if specified.
 4. Details: Installation details of each type installation condition in project; indicate installation details of glazing, if specified.
 5. Schedule: Indicate each door opening assembly in project; cross-reference to plans, elevations, and details.
- B. Selection Samples: Manufacturer's standard color chips.
- C. Verification Samples: Two (2) samples to verify color match.
- D. Manufacturer's Instructions: Printed installation instructions for door opening assemblies.
- E. Warranty Documents: Manufacturer's standard warranty documents, executed by manufacturer's representative, countersigned by CONTRACTOR.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Package door opening assemblies in manufacturer's standard containers.

B. Storage of Materials:

1. Store door assemblies in manufacturer's standard containers, on end, to prevent damage to face corners and edges.

PART 2 –PRODUCTS

2.1 MATERIALS

- A. Fiberglass Mat: Random glass fiber mat. Minimum 4.5 ounces per square foot weight of glass material.
- B. Kraft Honeycomb material: Phenolic resin impregnated; maximum flame spread 25 in accordance with ASTM E 84.
- C. Roving: Unidirectional glass fiber mat, minimum 16 ounces per square yard weight.
- D. Resins: Formulated for specified environment, minimum flame spread 25 in accordance with ASTM E 84, self-extinguishing in accordance with ASTM D 635.
- E. Anchors: Manufacturer's standard stainless-steel fasteners.
- F. Bonding Materials: Manufacturer's standard frame-to-opening bonding system.
- G. Joint Sealer: Sealant, specified in Section 07920, Joint Sealants.

2.2 FABRICATION

A. General:

1. Sizes and Profiles: The required sizes for door and frame units, and the profile requirements are shown on the Drawings. Variable dimensions for profiles (if any) are shown along with maximum and minimum dimensions as required to achieve design requirements and coordination with other work.
2. The details shown are based upon standard details by one or more manufacturers. Similar details by other manufacturers will be acceptable, provided they comply with the size requirements, and with minimum/maximum profile requirements as shown.

2.3 HARDWARE

- A. Flush Doors: Refer to Section 08710, Door Hardware, and to the frame, door and hardware schedules and details, for the furnishing and installing of hardware items.
- B. Hardware Installation: Cut, reinforce, drill and tap frames and doors as required to receive hardware, except do not drill and tap for surface-mounted items until the time of installation. Comply with hardware manufacturer's instructions and template requirements. Use concealed, stainless steel fasteners wherever possible.

2.4 MANUFACTURED UNITS

- A. Non-rated Fiberglass Reinforced Plastic (FRP) Doors:
 - 1. Thickness: 1-3/4 inches.
 - 2. Thermal Insulating Value: >R factor 12.
 - 3. Construction:
 - a. Style and Rail Structure: One-piece molded U-shaped cross-section, minimum 15 mil gel coat, minimum three (3) layers random-fiberglass mat, saturated with resins.
 - b. Core: Kraft honeycomb material.
 - c. Face Sheets: Molded in one continuous piece, resin reinforced with hand-laid glass fiber mat, nominal 1/8 inch thick, minimum 15 mil gel-coated surface with minimum two (2) layers random-fiberglass mat and one (1) layer roving, saturated with resins.
 - d. Door Edges: Minimum three (3) layers resin-reinforced glass fiber mat, nominal 3/8 inch thick, machine tooled.
 - 4. Sizes: Indicated on Drawings.
 - 5. Finish: Smooth gloss surface, minimum value 88 in accordance with ASTM D 523.
 - 6. Color: To be selected by ENGINEER.
- B. Non-rated Fiberglass Frames:
 - 1. Construction: One-piece molded cross-section with molded stop, minimum 15 mil gel coat, minimum two (2) layers random-fiberglass mat, saturated with resins polyurethane foam core. Sizes: For door sizes and frame depths indicated on Drawings.
 - 2. Frame Profile: 5-3/4 inches deep, 2 inches wide face; single rabbeted with 5/8-inch-high stop.
 - 3. Sizes: Indicated on Drawings.
 - 4. Finish: Satin finish, with true and consistent color throughout frame thickness.
 - 5. Color: To be selected by ENGINEER.
- C. Non-rated Fiberglass Reinforced Plastic (FRP) Doors shall be as manufactured by one of the following companies or equal:

1. Chem-Pruf Door Company
2. Edgewater Plastics
3. Simon Door Company
4. Tiger Door FRP
5. Or Equal

2.5 FABRICATION

- A. Fiberglass Reinforced Plastic (FRP) Doors: Workmanship is to be of the highest quality in order to meet quality control requirements.
 1. Stile and Rail Structure:
 - a. Form in mold of exact door size, with get coat layer to form, glass mat layers to a U-shaped channel interior.
 - b. Formulate get coat for environment and integral color specified.
 - c. Form structure as single component, jointed construction at intersections of stiles and rails is prohibited.
 - d. Form mortise for lockset, and recess for strike plate in lock stile, at time of molding.
 - e. Embed compression members at the time of molding in locations where thru- bolting of hardware is required.
 2. Core:
 - a. Fit honeycomb core material within stile/rail structure, fit around compression members and projections of mortises.
 - b. Mold openings for lites or louvers, if specified, form to sizes and at locations indicated.
 3. Face sheets:
 - a. Formulate get coat with integral color specified, embed glass materials.
 - b. Chemically bond face sheets to stile/rail structure and core material.
- B. Fiberglass Frames:
 1. Resin transfer in mold of exact wall opening size, with get coat. Glass mat layers to form solid fiberglass outer surface.
 2. Formulate get coat for environment and integral color specified.
 3. Form structure of fiberglass components.
 4. Form mortise for kick strike, and recess for strike plate in lock jamb, at time of molding.
 5. Embed reinforcement for hinges and other indicated hardware in fiberglass matrix, provide for hinge leaf recesses in hinge jamb at time of molding.

PART 3 – EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and his installer must examine the substrate and conditions under which doors and frames Work are to be installed and notify the ENGINEER in writing of any conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

3.2 INSTALLATION

- A. Install door opening assemblies in accordance with shop drawings, SDI-100, and manufacturer's printed installation instructions, using installation methods and materials specified in installation instructions.
- B. Installation of door hardware is specified in Section 08710, Door Hardware.
- C. Install door hardware in accordance with manufacturer's printed instructions, using through-bolts to secure surface applied hardware.
- D. Site Tolerances: Maintain plumb and level tolerances specified in manufacturer's printed installation instructions.

3.3 CLEANING AND REPAIRING

- A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding, and to remain in place at any angle without being moved by gravitational influence.
- B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.
- C. Clean surfaces of door opening assemblies and sight-exposed door hardware in accordance with manufacturer's maintenance instructions.
- D. Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection.

END OF SECTION

SECTION 08 91 19

FIXED LOUVERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes fixed extruded-aluminum louvers, rectangle, square, and gable end / triangle louvers.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- C. Samples: For each type of metal finish required.
- D. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on tests performed according to AMCA 500-L.
- B. Sample warranties.

1.04 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.05 WARRANTY

- A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
- C.
 - 1. Wind Loads: Determine loads based on a uniform pressure of 30 lbf/sq. ft. acting inward or outward.
- D. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
- E.
 - 1. Component Importance Factor: 1.5
- F. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

2.02 FIXED EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Wind-Driven-Rain-Resistant Louver
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airolite Company, LLC (The).
 - b. Greenheck Fan Corporation.
 - c. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - d.
 - 2. Louver Depth: 6 inches minimum

3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
4. Louver Performance Ratings:
 - a. Free Area: Not less than 7.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
 - b. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 300 fpm
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
6. Gable End / Triangle Louver to follow roof slope and dimensions as provided on drawings. Coordinate with exact mechanical equipment requirements.
 - a. Same properties as above regarding fins and blades
 - b. Louver to come in two (2) pieces, one left and one right half triangle.

2.03 LOUVER SCREENS

- A. General: Provide screen at each exterior louver
 1. Screen Location for Fixed Louvers: Interior face.
 2. Screening Type: Bird screening and insect screening
- B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.
- C. Louver Screening for Aluminum Louvers:
 1. Bird Screening: Stainless steel, 1/2-inch-square mesh, 0.047-inch wire.
 2. Insect Screening: Stainless steel, 18-by-18 mesh, 0.009-inch wire.

2.04 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless-steel fasteners.
 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or

equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.

- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.05 FABRICATION

- A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.06 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.02 ADJUSTING

- A. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION

SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers field painting and coating of surfaces, complete. Shop painting of metal items is specified under the applicable item.
- B. A schedule listing the various types of surfaces to be painted and the types of paints to be applied is included herein.
- C. Unless otherwise indicated, the following items shall not be painted:
 - 1. Labels on equipment, such as Underwriters' Laboratories and Factory Mutual, equipment identification, performance rating, and name or nomenclature plates.
 - 2. Moving parts of operating units, exposed bolt threads, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts.
 - 3. Electrical conduit unless mounted on painted or finished surfaces or exposed in a finished room.
 - 4. Structural steel not exposed to view, and other parts of buildings also not exposed to view.
 - 5. Stainless steel.
 - 6. Concrete.
 - 7. Plumbing fixtures.
 - 8. Fiberglass and polyethylene storage tanks.
 - 9. Uninsulated PVC piping (to be banded only)
 - * 10. Factory prefinished architectural components.
 - * 11. Electrical panels and cabinets factory finish painted.

* Except for touch-up painting when required

1.02 RELATED WORK:

- B. Section 05 50 00, MISCELLANEOUS METALS
- D. Section 09 96 56, PROTECTIVE COATING
- E. Section 09 97 13.33, SURFACE PREPARATION AND SHOP PRIME PAINTING

1.03 SYSTEM DESCRIPTION:

- A. The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, and other coatings, organic or inorganic, whether used as prime, intermediate, or finish coats.
- B. The Contractor shall do a complete painting job throughout the work in accordance with generally approved modern practices for work of high quality. Unless otherwise specified, all materials and surfaces customarily painted shall be given not less than one shop coat and two field coats or one prime coat and two finish coats, regardless of whether or not the surface to be painted is specifically mentioned.
- C. Paints containing lead shall not be used.
- D. To ensure a satisfactory painting job it is essential that the paints applied in the shop and in the field be mutually compatible. The Contractor shall determine what shop paints have been used and shall verify that field applied paints are compatible therewith.
- E. The colors of finish coatings shall be selected by the Engineer from color chips submitted by the Contractor for review. The color selection shall be in the form of a schedule indicating the colors to be used on the various surfaces. The colors used in the final work shall be in accordance with the color schedule and shall match the selected color chips.
- F. All coating systems used for potable water applications shall be previously approved by the National Sanitation Foundation (N.S.F.) in accordance with Standard 61. Evidence of such approval shall be an approval letter from N.S.F. listing the submitted materials.
- G. Paints submitted shall meet all Federal and State E.P.A. regulations pertaining to volatile organic compounds (VOC) compliance.

1.04 REFERENCES:

- A. The following standards form a part of these specifications, and indicate the minimum standards required:

American Society for Testing and Materials (ASTM)

ASTM F1869 Moisture Vapor Emission Rate Using Anhydrous Calcium Chloride

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23
SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer's literature of proposed paints.
- B. Painting schedule.
- C. Two (2) sets of color chips for selection of colors.

1.06 DELIVERY AND STORAGE:

- A. Paint shall be delivered to the site in the manufacturer's sealed containers. Each container shall bear the manufacturer's label, listing the brand name, type and color of paint, and instructions for thinning. Thinning shall be done only in accordance with directions of the manufacturer. Job mixing or job tinting may be done when approved by the Engineer and for preparing sample colors.
- B. Painting materials shall be stored and mixed in a single location designated by the Engineer for this purpose. The Contractor shall not use any plumbing fixture or pipe for mixing or for disposal of any refuse. It shall carry all necessary water to its mixing room, and shall dispose of all waste outside of the building in a suitable receptacle. The Contractor will be held responsible for any damage done due to failure to observe these precautions.
- C. The paint storage area shall be kept clean at all times, and any damage thereto or to its surroundings shall be repaired. Any oily rags, waste, etc., shall be removed from the building every night, and every precaution shall be taken to avoid danger of fire.
- D. Heat must be provided in the storage area if paints are to be stored during winter months. The temperature shall be maintained above 40 degrees F. at all times.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. PAINT SCHEDULE:

Except as otherwise indicated, all paint used shall be of the type listed in the schedule below, by Tnemec Company, Inc., or equivalent paints by Sherwin-Williams Company, International Paints, or other approved paint fully equal to paint manufactured by the above named companies. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following painting schedule are submitted in writing to the Engineer, along with sufficient data supported by certified tests.

PAINT SCHEDULE

<u>Key</u>		<u>Tnemec</u>	<u>Note 1</u>
AGE	Acryli Gloss Enamel	1029 Enduratone	3.5
APE	Acrylic Polyurethane	73 Endura-Shield Enamel	3.0
ABF	Cementitious Block Filler	130 Envirofill	80-100 s.f./gal
BO	Bleaching Oil	Note 5	
CEE	Catalyzed Epoxy	L69F Epoxoline II	4.0
CEM	Catalyzed Epoxy Mastic	27 WB Typoxy	Note 3
CEP	Catalyzed Epoxy Primer	L69F Epoxoline	3.0
EMC	Epoxy Modified Cement	218 Mortar-Clad	Fill/Surface
EP	Epoxy-Polyamide (thinned 30% #4 thinner)	FC 22 Pota-pox	25-30
EPW	Water-based Epoxy Primer	151 Elasto-Grip	1.0-1.5
HGV	High Gloss Varnish		Note 2
HSE	High Solids Epoxy (Minimum 69%)	L69 Epoxy	6.0
MA	Modified Acrylic	115 Uni-bond	3.0
MAE	Modified Acrylic Elastomer	156 Envirocrete	6.0-8.0
MCU	Moisture Cured Urethane	Series 1 - Omnithane	2.5-3.0
MPE	Modified Polyamine Epoxy	Series 435 - Permaglaze	15-20 mils
NE	Novolac Epoxy	282 Tneme-Glaze	7.5
PEF	Polyamine Epoxy Finish	280 Tneme-Glaze	6.0-8.0
PEP	Polyamine Epoxy Primer	201 Epoxoprime	6.0-8.0
PVA	PVA Sealer	151 Elasto Grip	0.75-1.5
PWC	Potable Water Coating	Series FC 22 Pota Pox	25-30
SA	Silicone Aluminum	39-1261 (Note 4)	1.5
VB	Vapor Barrier	262 Elasto Shield	50-100
WP	Wood Primer	151 Elasto-Grip	1.0-1.5

<u>Key</u>		<u>Tnemec</u>	<u>Note 1</u>
WS	Wood Sealer	Note 2	-
Z	Zinc-Rich Primer	90G-1K97 Tneme-Zinc	2.5

- Notes
- 1: Minimum Dry Film Thickness/Coat (mils)
 - 2: Furnished by reputable manufacturer and acceptable to the Engineer.
 - 3: Shall be used as a tie-coat between incompatible paints @ 3.0-4.0 mils.
 - 4: This paint is suitable for temperatures up to 1200°F and must be final cured at 400°F for one hour.
 - 5: Bleaching oil is a translucent gray paint stain with a chemical additive to enhance the natural bleaching tendencies of cedar shingles.

B. PAINTING SCHEDULE:

Paint shall be applied in accordance with the paint key listed on the following schedule and defined in the preceding Paint Schedule:

<u>Item</u>	<u>Field Coats</u>			
	1st	2nd	3 rd	
<u>Walls:</u>				
Interior concrete masonry units	ABF	HSE	HSE	
Interior concrete designated to be painted, to include top and outside of all concrete containment curbs	HSE	HSE	--	
Interior chemical containment curbs on the chemical storage side	PEP	NE	NE	
Exterior concrete masonry units (if sprayed, backroll first coat)***	MAE	MAE	--	
Exterior wood shingles	BO	BO	--	
Plaster & gypsum wallboard	PVA	HSE	HSE	
<u>Ceilings and Walls:</u>				
Exposed galvanized metal deck/bar joists, dry spaces^	MA	--	--	
Exposed galvanized metal deck/bar joists, wet spaces^	CEE			
Exposed galvanized wall panel	CEE	CEE	--	
Plaster & gypsum wallboard	PVA	CEE	CEE	
<u>Equipment Items:</u>				
With shop prime coat, including machinery and pumps (non-submerged) (submerged)	Interior	*CEP	CEE	--
	Exterior	*CEP	APE	
	Exterior	MPE	MPE	

With shop finish coat (when designated to Interior be painted)	*CEM	CEE	--
	*CEM	APE	

Metals:

Exposed interior structural steel including monorails and supports	*Z	CEE	CEE
--	----	-----	-----

Exposed exterior structural steel including monorails and supports	*Z	CEE	APE
--	----	-----	-----

Interior miscellaneous galvanized and non-ferrous metals and piping	CEE	CEE	--
---	-----	-----	----

Exterior miscellaneous galvanized and non ferrous metals and piping (SP7 required)	CEE	APE	--
--	-----	-----	----

Miscellaneous interior ferrous piping, metalwork, ferrous parts or operating devices, valve handles, levers, pumps, and ferrous hangers and supports (exterior exposure)	CEP	CEE	--
--	-----	-----	----

	CEP	CEE	APE
--	-----	-----	-----

Exposed electrical conduit, conduit fittings, outlet boxes	Same as adjacent wall or ceiling		
--	----------------------------------	--	--

Hot ferrous metal surface	SA	SA	--
---------------------------	----	----	----

Wood and Carpentry Items:

Wood trim (natural finish)	WS	HGV	HGV
----------------------------	----	-----	-----

Wood trim (unprimed)	WP	AGE	AGE
----------------------	----	-----	-----

Doors and Frames:

Interior hollow metal doors, frames and panels	AGE	AGE	--
--	-----	-----	----

Exterior hollow metal doors	AGE	AGE	--
-----------------------------	-----	-----	----

Interior wood doors (painted)	WP	AGE	AGE
-------------------------------	----	-----	-----

Interior wood doors (natural)	HGV	HGV	--
-------------------------------	-----	-----	----

Piping:

PVC Piping designated to be painted (SP7 or hand sand)	CEE	CEE	--
--	-----	-----	----

Pipe insulation (plastic or metal sheathed paint as scheduled for plastic or metal surface)	PVA	CEE	CEE
---	-----	-----	-----

Other piping (see metals)

* Spot Prime

***For existing, painted masonry walls, use EPW primer, followed by two coats of MAE.

- ^ If galvanized metal is provided with a light top coat sealer, light brush blast surface preparation is required prior to first field coat

B. SPARE PAINT:

1. Furnish to the Owner one unopened gallon of each type and color of paint used on the work.
2. Furnish both components for each type and color of epoxy paints used on the work.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. Before any surface is painted, it shall be cleaned carefully of all dust, dirt, grease, loose rust, mill scale, old weathered paint, efflorescence, etc. All necessary special preparatory treatment shall then be applied. Where required, imperfections and holes in surfaces to be painted shall be filled in an approved manner.
- B. Cleaning and painting shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surfaces which have been cleaned, pretreated, or otherwise prepared for painting, shall be painted with the first field coat as soon as practicable after such preparation has been completed, but in any event prior to any deterioration of the prepared surface.
- D. Wood shall be sanded to a smooth and even surface and then dusted off. Before priming wood that is to be painted, shellac shall be applied to all knots, pitch and sapwood. After priming or stain coat has been applied, nail holes and cracks shall be thoroughly filled with plastic wood or putty. For natural finish work, putty shall be colored to be imperceptible in the finished work.
- E. Exposed nails and other ferrous metal or surfaces to be painted with water-thinned paint shall be spot primed with aluminum.
- F. Cracks and holes in masonry and concrete surfaces to be painted shall be filled with patching material recommended by the coatings manufacturer. Surfaces shall be clean and dry before painting. All efflorescence, grease, oil, etc., shall be removed before painting, and all loose, crumbling material shall be removed by vigorous wire brushing over entire surface, followed by removal of all dust. All high areas on masonry and concrete surfaces such as mortar daubs, mortar ridges at joints, and ridges at form joints in concrete shall be removed.
- G. All holes in plaster shall be filled with plaster of paris and all cracks shall be cut out and filled. No sandpaper shall be used on plastered surfaces. Prior to painting, surfaces shall be tested with a moisture detecting device, such as Kaydel Plaster Tester, Type CP-48, as

manufactured by Hard Moisture Gauges, Inc. No sealer or paint shall be applied when the moisture content of the plaster exceeds 8 percent, as determined by the test. Testing shall be done in the presence of the Engineer's representative, and in as many locations as directed. Plaster shall be thoroughly dry-brushed before painting or sealing.

- H. All nonferrous metal surfaces to be painted shall be cleaned of all dirt, grease, oil and other foreign substances uniformly profiled per SSPC SP 7.
- I. All galvanized surfaces to be painted shall be brush blasted to create a uniform surface profile per SSPC SP7.
- J. Before application of the first full field coat, abraded areas of all non-galvanized ferrous metal items having shop coats shall be touched up with paint of the type indicated on the Painting Schedule.
- K. All items of equipment such as motors, pumps, instrumentation panels, electrical switchgear, and similar items, that have been given shop coats, paint filler, enamel or other treatment customary with the manufacturer, shall have, after installation, all scratches and blemishes touch up prior to application of the first field coat. Factory prefinished items not to be field painted shall be touched up with matching paint to repair any areas damaged during installation.
- L. All submerged concrete surfaces that are to receive an epoxy coating shall be brush blasted to remove surface laitance and provide a uniform surface profile, reference SSPC SP #13. Surface preparation may commence one week after the concrete has been pronounced cured. The curing period is defined as that length of time during which the concrete is fully hydrated (28 day cure). Patch holes and voids with specified modified epoxy cement prior to coating.
- M. Concrete floors that are to receive epoxy coating shall be brush blasted or shot blasted per SSPC SP #13 and ICRI Surface Profile requirements per the coating manufacturer (Blastrack). Check for excessive moisture migration per ASTM F1869, Moisture Vapor Emission Rate Using Anhydrous Calcium Chloride. Test results not to exceed 3 lbs per 1,000 square feet in one 24-hour period.
- N. Hardware accessories, machine surfaces, plates, lighting fixtures, and similar items in place prior to cleaning and painting, and not intended to be painted, shall be removed during painting operations and repositioned upon completion of each area or shall otherwise be protected.
- O. All PVC pipe to be painted shall be brush blasted per SSPC SP7 or shall be sanded to provide a uniform surface profile.

3.02 APPLICATION:

- A. Paint shall be used and applied as recommended by the manufacturer without being extended or modified, and with particular attention to the correct preparation and condition of surfaces to be painted.
- B. Paint shall be applied only within the temperature range recommended by the manufacturer. Painting of surfaces when they are exposed to the sun shall be avoided.
- C. Paint shall not be applied to wet or damp surfaces and shall not be applied in rain, snow, fog, or mist, or when the relative humidity exceeds 85 percent.
- D. No paint shall be applied when it is expected that the relative humidity will exceed 85 percent or that the air temperature will drop below 40°F within 18 hours after the application of paint. Dew or moisture condensation should be anticipated and if such conditions are prevalent, painting shall be delayed until midmorning to be certain that the surfaces are dry. Further, the days painting should be completed well in advance of the probable time of day when condensation will occur, in order to permit the film an appreciable drying time prior to the formation of moisture.
- E. All paint shall be applied under favorable conditions by skilled painters and shall be brushed out carefully to a smooth, even coating without run or sags. Enamel shall be applied evenly and smoothly. Each coat of paint shall be allowed to dry thoroughly, not only on the surface but also throughout the thickness of the paint film before the next coat is applied. Finish surfaces shall be uniform in finish and color, and free from flash spots and brush marks. In all cases, the paint film produced shall be satisfactory in all respects to the Engineer.
- F. Exposed nails and other ferrous metal or surfaces to be painted with water-thinned paints shall be spot primed with aluminum paints.
- G. In order to provide contrast between successive coats, each coat shall be of such tint as will distinguish it from preceding coats.
- H. The Contractor shall not only protect its work at all times, but shall also protect all adjacent work and materials by the use of sufficient drop cloths during the progress of the work. Upon completion of the work, it shall clean up all paint, spots, oil, and stains from floors, glass, hardware, and similar finished items.
- I. Paint shall be applied so as to obtain coverage per gallon and the dry film thickness recommended by the manufacturer. Dry film thickness readings shall be taken to insure that required thicknesses have been achieved. The Contractor shall record in a manner satisfactory to the Engineer, the quantities of paint used for successive coats on the various parts of the work.
- J. Spraying with adequate apparatus may be substituted for brush application of those paints and in those locations for which spraying is suitable.

- K. If paints are thinned for spraying, the film thickness after application shall be the same as though the unthinned paint were applied by brush. That is, the addition of a thinner shall not be used as a means of extending the coverage of the paint, but the area covered shall be no greater than the area that would have been covered with the same quantity of unthinned paint.
- L. Blast cleaned metal surfaces shall be coated immediately after cleaning, before any rusting or other deterioration or contamination of the surface occurs. Blast cleaned surfaces shall be coated not later than 8 hours after cleaning under ideal conditions or sooner if conditions are not ideal.
- M. The use of carbon dioxide or carbon monoxide emitting heaters is not permitted during the painting operation. Only indirect hot-air systems shall be permitted.

3.03 PIPING COLOR CODE:

The following Tnemec colors shall be utilized to facilitate identification of piping. Only insulation is to be painted on chemical feed lines.

1. Water Lines

Raw	Olive Green	110GN
Settled or Clarified	Aqua	10GN
Finished or Potable	Dark Blue	11SF

2. Wastewater or Potable Waste Lines

Sewer (sanitary or drain)	Dark Gray	34GR
Backwash Waste	Light Brown	68BR
Sludge	Dark Brown	84BR
Sewage Plant Effluent	Clay	07RD

3. Chemical Lines

Alum or Primary Coagulant	Orange	04SF
Ammonia	White	11WH
Carbon Dioxide (Gas, Liquid and Solution)	Light Red	26RD
Carbon Slurry	Black	35GR
Caustic Compounds (NaOH Or KOH)	Yellow with Green Band	02SF/09SF
Chlorine (Gas and Solution)	Yellow	02SF
Chlorine Dioxide	Yellow with Violet Band	02SF/14SF
Ferric Chloride	Orange	04SF
Fluoride Compounds	Light Blue with Red Band	25BL/06SF

Lime Slurry	Light Green	08GN
Ozone	Yellow with Orange Band	02SF/04SF
Phosphate Compounds	Light Green with Red Band	08GN/06SF
Polymers or Coagulant Aids	Orange with Green Band	04SF/09SF
Potassium Permanganate	Violet	14SF
Soda Ash	Light Green with Orange Band	08GN/04SF
Sulfuric Acid	Yellow with Red Band	02SF/06SF
Sulfur Dioxide	Light Green with Yellow Band	08GN/02SF

4. Other

Compressed Air	Dark Green	91GN
Gas or Oil	Red	28RD
Other Lines	Light Gray	32GR

- B. In situations where two colors do not have sufficient contrast to easily differentiate between them, a 6-inch band of contrasting color shall be painted on one of the pipes at approximately 30-inch intervals.
- C. Piping which is not painted shall be color coded with bands placed at each change in direction and no more than 5 feet apart on straight runs.

3.04 PIPING IDENTIFICATION:

- A. After painting, piping shall be identified by stenciling using the same specified paint as used on the pipes. Stenciling shall be of wording and color selected by the Engineer and sized as follows:

<u>Outside Diameter of Pipe or Covering</u>	<u>Size of Legend Letters</u>
3/4-inch to 1-1/4-inch	2-inch
1-1/2-inch to 2-inch	3/4-inch
2-1/2-inch to 6-inch	1-1/4-inch
8-inch to 10-inch	2-1/2-inch
Over 10-inch	3-1/2-inch

- B. Arrows shall indicate direction of flows. Where "a" is equal to 3/4 of outside diameter of pipe or covering, the arrow shaft shall be 2 "a" long by 3/8 "a" wide. The arrow head shall be an equilateral triangle with sides equal to "a." Maximum "a" dimension shall be 6-inches.

- C. Where pipe passes through a wall, use pipe markers and directional arrows on each side of the wall.
- D. Use pipe markers and directional arrows every 50 feet along continuous pipe lines.
- E. Use a pipe marker and directional arrow at each rise and "T" joint.
- F. When using directional arrows, point arrowhead away from pipe markers and in direction of flow. If flow can be in both directions, use a double-headed directional arrow.
- G. The Engineer will assist in determining pipe content and direction of flows.

3.05 PARKING LOT LINE PAINTING:

- A. Paint for parking lot lines shall conform to Federal Specification TT-P-115-E Type I. Paint shall be 11-3 PPG Industries, Pittsburgh, PA, Series 6 Tneme-Cryl, Tnemec, St. Louis, MO, or approved equal.
- B. Contractor shall prepare the pavement surface according to the recommendations of the paint manufacturer.
- C. Applied markings shall have clean-cut edges, true and smooth alignment and uniform film thickness of 15 mils, ± 1.0 .
- D. The Contractor shall be responsible for removing, to the satisfaction of the Engineer, tracing marks, and spilled paint applied in an authorized area.

3.06 CLEANUP:

- A. The Contractor shall at all times keep the premises free from accumulation of waste material and rubbish caused by its employees or work. At the completion of the painting, it shall remove all tools, scaffolding, surplus materials, and rubbish from and about the buildings and shall leave the work "broom clean" unless more exactly specified.
- B. The Contractor shall also, upon completion, remove all paint where it has been spilled, splashed, or splattered on all surfaces, including floors, fixtures, equipment, furniture, glass, hardware, etc., leaving the work ready for inspection.

END OF SECTION

SECTION 09 96 56

PROTECTIVE COATING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide hydrogen sulfide resistant protective coating inside wetwell as indicated and specified.
 - 1. Apply mortar clad scratch coat to all interior concrete surfaces in wetwell.
 - 2. Apply hydrogen sulfide resistant top-coat to all interior concrete surfaces and piping in wetwell.

1.02 SUBMITTALS:

- A. Submit the following in accordance with Section 01 33 23:
 - 1. Submit manufacturer's product data, surface preparation, printed application and safety requirements.
 - 2. Submit manufacturer's written description, instructions and required results for field testing for moisture density (dryness), dry film thickness and holidays.
 - 3. Submit manufacturer's color charts.

1.03 QUALITY ASSURANCE:

- A. The protective coating system furnished under this specification shall be of products which are currently used in similar applications.
- B. The material furnished under this specification, when mixed and applied in accordance with the manufacturer's instructions, shall produce a high-quality protective coating suitable for immersion conditions.

1.04 SURFACES COATED:

- A. Apply scratch coat layer on all interior concrete surfaces of wetwell including walls, bottom of new top slab, and floors (after floor slope modifications).
- B. Apply protective top coating (two coats) to wetwell interior concrete surfaces (floors, walls, and bottom of top slab) and submerged ductile iron piping.

1.05 MANUFACTURER'S RECOMMENDATIONS:

- A. Conform to manufacturer's printed instructions for surface preparation, use, safety requirements, mixing, application, curing and intercoat precautions for protective coating. Submit to Engineer, four copies of these printed instructions and manufacturer's product data sheets, 30 days prior to application of coating.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Provide only high-grade products of nationally known manufacturer's having an established good reputation in the field. Provide products having a minimum of five years' similar, satisfactory field service and suitable for the intended service. Apply products specified except, when permitted by the Engineer, other acceptable equivalent products may be applied if the Contractor satisfactorily proves that they are equivalent to the specified item in quality, durability, performing the required function, abrasion resistance, chemical resistance, adhesion, efficiency in protecting the substrate from corrosion and deterioration, life expectancy and recoating cycles, solids content by volume, film thickness per coat, mil. feet per gallon, coverage per gallon, total cost of services, ease of application, ease of repairing damaged areas, and other pertinent criteria. In any one coating system, provide compatible coatings. Provide only products of one manufacturer in any one coating system. Touch-up with coatings as originally applied. Provide materials meeting air pollution requirements in the area where they are applied.
- B. Apply materials within the manufacturer's recommended shelf life.
- C. Deliver materials to the application area in their original, unopened containers plainly marked with the name and analysis of the product, the producer's name and the shelf life date. Do not use contaminated, outdated, prematurely opened, or diluted material. Do not modify or extend coatings and only use in accordance with the coating manufacturer's current printed instructions.

2.02 PROTECTIVE COATING:

- A. Manufacturers:
 - 1. Tnemec Company, N. Kansas City, MO.
 - 2. Sherwin Williams, Cleveland, OH.
 - 3. Or equal.

B. Coating System Description (Basis of Design):

1. Tnemec:

- a. Concrete hole filler—Tnemec Series 218/219 Mortar Clad (epoxy modified concrete). Apply as scratch coat to fill bug holes and voids.
- b. Two top coats—Tnemec Series 435 Perma-Glaze (modified polyamine epoxy) with a total dry film thickness of 80 mils.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. Clean surfaces as specified and recommended by the coating manufacturer before coating is started.
- B. Allow new concrete surfaces to cure for at least 28 days.
- C. Open up concrete blow holes by mechanical means to reveal any underlying cavities and fill with the coating manufacturer's recommended, suitable filler-sealer.
- D. Concrete: Sandblast clean concrete to remove laitance, and remove loose materials, dirt and dust from these areas by vacuum cleaning. Provide approximate, a surface profile texture of medium sand-paper for blast-cleaned concrete. Do not use acid etching. Surface profile texture shall be approved by the on-site technical representative of the protective coating manufacturer.
 1. Verify dryness by testing for moisture in accordance with coating manufacturer's printed instructions for vertical and horizontal surfaces. Test results shall be approved by coating manufacturer.
- E. Metal: SSPC-SP5—White Metal Blast Cleaning with a 4.0 mil minimum anchor profile and in accordance with coating manufacturers printed instructions.

3.02 APPLICATION:

- A. Application shall be in accordance with coating manufacturer's printed instructions. Conform to coating manufacturer's printed instructions with regard to safety requirements prior to and during application of coating system.
- B. The Contractor's attention is directed to the manufacturer's requirements concerning the temperatures to be maintained before, during and following the application of the coatings.
- C. Carefully apply coating to avoid thin spots at edges, corners, joints, and seams. Effectively seal seams and interfaces of concrete within the specified areas.

- D. Provide finished coating free of pinholes, holidays, foreign inclusions, and bubbles. Carefully examine coated areas to ensure that these requirements have been complied with. Repair lining in defective areas by spot blasting and re-coating as recommended by the manufacturer and at no additional cost to Owner.

3.03 FIELD TESTING:

- A. Perform field testing for actual dry film thickness of coating after application.
- B. Perform holiday testing.
- C. Dry film thickness and holiday testing shall be performed in accordance with coating manufacturer's printed instructions. Test results shall be approved by the on-site technical representative of the coating manufacturer.

3.04 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01 78 00.

END OF SECTION

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SECTION 09 97 13.33

SURFACE PREPARATION AND SHOP PRIME PAINTING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers the furnishing of all labor, materials, equipment and incidentals required for the surface preparation and application of shop primers on ferrous metals, excluding stainless steels, as specified herein.

1.02 RELATED WORK:

Field painting is included in Section 09 90 00.

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Submit to the Engineer for review, manufacturer's specifications and data on the proposed primers and detailed surface preparation, application procedures and dry mil thicknesses.
- B. Submit representative physical samples of the proposed primers, if required by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Submerged surfaces - Shop primer for ferrous metals exposed to wastewater which will be submerged or which are subject to splash action or which are specified to be considered a submerged surface shall be spray applied one coat of Tnemec 394 PerimePrime primer, dry film thickness 2.5 to 3.5 mils by Tnemec Co., or approved equal.
- B. Non-galvanized Miscellaneous Metals - spray apply one coat Tnemec 394 PerimePrime MIO/zinc primer or approved equal.
- C. Other Non-Galvanized and Non-Submerged Surfaces including process equipment - Spray apply one coat of Tnemec Series 394 by Tnemec Co.; or approved equal.
- D. Non-Primer Surfaces - Gears, bearings surfaces, and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.

- E. Compatibility of Coating Systems - Shop priming shall be performed with materials specified above. However, shop painting shall be done with primers that are guaranteed by the manufacturer to be compatible with the corresponding finish coats specified in Section 09 90 00.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. Non-submerged service components scheduled for priming, as defined above, shall be sand blasted clean in accordance with SSPC-SP-6, Commercial Grade, immediately prior to priming.
- B. Submerged service components scheduled for priming, as defined above, shall be sandblasted clean in accordance with SSPC-SP-10, near White, immediately prior to priming.
- C. Surface shall be dry and free of dust, oil, grease and other foreign material before priming.
- D. Shop prime in accordance with approved manufacturer's recommendations.

END OF SECTION

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SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.03 ACTION SUBMITTALS:

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.04 INFORMATIONAL SUBMITTALS:

- A. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.06 COORDINATION:

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.07 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
 - b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.02 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS:

- A. Fire Extinguishers: Type, size, and capacity for each and mounting bracket indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - b. Kidde Residential and Commercial Division.
 - c. Larsens Manufacturing Company.
 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
 3. Valves: Manufacturer's standard
 4. Handles and Levers: Manufacturer's standard
 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging
- B. Multipurpose Dry-Chemical Type in Steel Container, UL-rated 4-A:60-B:C, 10-lb, nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.03 MOUNTING BRACKETS:

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - b. Kidde Residential and Commercial Division.
 - c. Larsens Manufacturing Company.
 - 2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: Top of fire extinguisher to be as indicated above finished floor.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 23 00 50

BASIC HVAC REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY:

- A. The work of Division 23 is governed by the General and Supplementary Conditions of the Contract, and Sections of Division 1 of the Project Manual.
- B. Perform work and provide materials and equipment as shown on Drawings and as specified or referenced in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide complete and fully functional systems installation.
- C. Give notices, file plans, obtain permits and licenses, pay fees and backcharges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with the Contract Documents.
- D. Section Includes: The work of this Section includes the basic requirements common to the HVAC Sections of Division 23, including:
 - 1. Definitions,
 - 2. Organization of submittals,
 - 3. Proposed substitutions,
 - 4. Core drilling,
 - 5. Cutting and Patching,
 - 6. Sleeves and penetrations,
 - 7. Coordination drawings,
 - 8. Valve tags,
 - 9. Equipment and piping identification,
 - 10. Record documents,

11. Systems start-ups,
 12. Access Panels,
 13. Fire Watch,
 14. Scaffolding, hoisting, rigging and staging,
- E. Related Sections: Related work specified in other Sections includes, but is not necessarily limited to:
1. Section 01 33 13 – Submittals.
 2. Section 01 73 29 – Cutting, Coring, and Patching: Openings in masonry, concrete, tile, and other parts of structure, except drilling for hangers, providing holes and openings in metal decks, and core drilling.
 3. Section 01 92 13 – Operations and Maintenance Manuals.
 4. Section 03 33 00 – Cast-in-Place Concrete: Housekeeping pads and inertia pads.
 5. Section 05 50 00 - Metal Fabrications: Structural supports necessary to distribute loading from equipment to roof, floor, walls or other building structural components.
 6. Section 07 62 00 - Sheet Metal Flashing and Trim.
 7. Section 07 84 43 – Fire Stopping: Caulking of pipe and duct penetrations through floor slabs and fire-rated or smoke partitions.
 8. Section 07 92 00 – Joint Sealants: Sealing joints between plumbing fixtures and abutting surfaces.
 9. Section 09 00 00 – Painting: Painting of exposed piping and equipment except as specified in this Section.
 10. Division 22 – Plumbing
 11. Division 23 – HVAC
 12. Division 26 – Electrical.

1.2 REFERENCES:

- A. American National Standards Institute (ANSI)
 - 1. ANSI A13.1 - Scheme for the Identification of piping systems.
- B. ASTM International (ASTM)
 - 1. ASTM E119 - Test Methods for Fire Tests of Building Construction and Materials.
 - 2. ASTM E814 - Test Method for Fire Tests of Through-Penetration Fire Stops.
- C. Construction Specifications Institute. (CSI)
 - 1. Manual of Practice
- D. Underwriters Laboratories (UL)
 - 1. Fire Resistance Directory, Vol. I - Beams, Columns, Floors, Roofs, Walls, and Partitions.
 - 2. Fire Resistance Directory, Vol. II, Through Penetration Firestop Systems.
 - 3. ANSI/UL1479 - Fire Tests of Through Penetration Firestops.
- E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
 - 1. Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.
- F. National Fire Protection Association
 - 1. No. 241-Safeguarding Construction, Alteration, and Demolition Operations.
- G. International Code Council (ICC):
 - 1. International Building Code – IBC 2018.
 - 2. International Plumbing Code – IPC 2018.
 - 3. International Mechanical Code – IMC 2018.
 - 4. International Fire Prevention Code – IFPC 2018.
 - 5. International Energy Conservation Code – IECC 2018

1.3 DEFINITIONS:

- A. General: Words and terminology used throughout the HVAC Sections of Division 23 shall be understood in their common usage as defined in a common dictionary, and as further defined in the CSI Manual of Practice, the General and Supplemental Conditions of the Contract, Division 1 of the Project Manual, and the Sections of Division 23.
- B. Specification Content: The HVAC Specification Sections in Division 23 may use certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 - 1. Abbreviated Language: Language used in Specifications and other Contract Documents maybe of the abbreviated style. Words and meanings shall be interpreted as appropriate. Words implied, but not stated shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
 - 2. Streamlined Language: The Specifications generally use the imperative mood and streamlined language. Requirements expressed in the imperative mood shall be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.
 - A. The words "shall be" are implied where a colon (:) is used within a sentence or phrase.
- C. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, or other paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the reader locate the reference. Location is not limited.
- D. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Engineers, requested by the Architect, and similar phrases.
- E. Approved: When used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, The term "approved," is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contract.

- F. **Furnish:** Furnish means purchase, delivery and storage at the Project Site for installation under other Sections or by the Owner.
- G. **Install:** Includes operations at the Project Site including the actual unpacking, preparation, assembly, erecting, placing, anchoring, supporting, connecting, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations required for a complete installation ready for the intended use.
- H. **Provide:** Provide means to furnish and install.
- I. **Project Site:** Project Site is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- J. **Testing Agencies:** A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
- K. **Product Data:** Product data sheets include the manufacturers standard catalog information with illustrations, standard schedules, diagrams, performance charts, instructions, and brochures that illustrate physical appearance, size, weight, and other general characteristics of materials and equipment for some portion of the work.
- L. **Shop Drawings:** Shop drawings are detailed drawings, diagrams, illustrations, and schedules specifically prepared by the installing contractor or supplier to illustrate some portion of the work.
- M. **Fabrication Drawings:** The installation shop drawings required by the work of the various Sections of the Project Manual, such as sheet metal and sprinkler shop drawings, and normally prepared by the installing sub-contractor.
- N. **Coordination Drawings:** The coordinated installation shop drawings normally prepared by the installing sub-contractors indicating multiple building systems and interdisciplinary work on a single set of coordinated documents.
- O. **Substitutions:** Substitutions include manufacturers not listed as acceptable within the specifications, or materials, products, systems, or equipment, which differ from the requirements of the Contract Documents.
- P. **Regulations:** Regulations includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

- Q. NRTL: Nationally Recognized Testing Laboratory such as Underwriters Laboratory, Inc. or Factory Mutual Research Corporation.
- R. Life Safety Systems: Life Safety Systems include all fire protection systems, devices, and equipment used to detect fire, activate alarms, suppress or control fire and smoke, or any combination thereof.

1.4 SUBMITTALS:

- A. General Requirements: Comply with pertinent Submittals, the Sections of Division 23 - HVAC, and the additional requirements of this Section.
- B. Materials List: Within 30 calendar days after the Contractor has received the Owner's Notice to proceed, submit a list of the proposed materials to be provided under the work of the HVAC Sections of Division 23.
- C. Organization of Submittals: Organize submittals into comprehensible packages with related product data sheets and shop drawings organized and identified by Specification Section and Article numbers and titles. Organize submittals into packages in order as specified in the Sections of Division 23. Identify submittal pages to indicate the specific equipment or fixture type the data sheet applies to by Article number and title. Submittals, which are not properly bound and identified, may be returned without review.
 - 1. Indicate appropriate model numbers in manufacturers' brochures and cross out non-applicable information.
 - 2. Copies of faxed pages are unacceptable.
 - 3. Submit shop drawings for particular systems complete, simultaneously, and organized by system.
- D. Submittal Cover Sheet: Provide a completed cover sheet with each submittal package indicating the information on the following sample page:

SUBMITTAL COVER SHEET		
PROJECT:	CONTRACTOR:	
SECTION NO.:	ARTICLE NO.:	
DESCRIPTION:		
CONTRACT DRAWING REFERENCE NO.:		
EQUIPMENT IDENTIFICATION TAG NUMBER:		
SUBMISSION (CIRCLE ONE): FIRST, SECOND, THIRD, FOURTH		
DATE:		
INFORMATION AND CHECKLIST	REPLY	COMMENTS
1. Contractor's Log #ID		
2. Name, address, and phone number of supplier.		
3. Are all specified or scheduled items included and exactly match scheduled/specified items?	Yes No	
4. Is this item a substitution?	Yes No	
5. Are deviations clearly identified?	Yes No	
6. Does equipment fit space shown on construction documents, coordination drawings, and actual field conditions?	Yes No	
7. Has support, erection, weights, and installation been coordinated with all trades?	Yes No	
8. Does the proposed installation void warranties or violate UL or code requirements?	Yes No	
9. Does this material/equipment add expense to any other trade or project costs?	Yes No	
10. Does equipment require interface with other trades? List sections and specifics requiring coordination?	Yes No	
11. Is control interface coordinated?	Yes No	
12. List electrical characteristics (V/Ph/A)		

- E. After approval of the proposed materials list, provide complete submittals as soon as possible and with adequate time for processing in order to not delay the project.
- F. Submit for review of all project specific electronic reproducible drawings one electronic copy in Portable Document Format (PDF). If submitting hard copies, submit for review eight sets of detailed Shop Drawings and Product Data. Submittals for review shall include complete Specifications, including type of materials, electrical characteristics, capacities, performance and power requirements to determine compliance with Contract Documents. All data submitted including wiring diagrams shall be complete for all equipment and shall apply only to this specific project. All extraneous material shall be deleted or marked out. Items to be supplied shall be specifically indicated using a method that will be visible after photocopying.
- G. Contractor's Review: Review, stamp and certify each submittal prior to submission to the Architect. The certification shall state that the data and details contained on each Shop Drawing, Product Data, layout drawing, catalog data and brochure has been reviewed and that it complies with the Contract Documents in all respects. Shop Drawings, layout drawings, catalog data and brochures will not be reviewed and will be returned unchecked unless they are certified and all items specifically identified.
- H. Multiple submissions: It is intended that Submittal data be complete and accurate at the first submission. If the Submittal is returned marked "Resubmit" only one additional submission will be permitted.
 - 1. If the second submission is not acceptable, or if the submittal is not made within the specified time frame, the right of substitution and selection will be lost. At that time, the specified item shall be provided at no additional cost.
- I. Required Review Time: A minimum period of ten working days, exclusive of transmittal time, will be required in the Engineer's office each time Shop Drawings, Product Data, layout drawings, catalog data and brochures are submitted or resubmitted for review. A minimum period of fifteen working days exclusive of transmittal time will be required for reviewing substitute materials or manufacturer. The required review time, including multiple submission, shall be considered when scheduling the work.
- J. Submit Shop Drawings and Product Data sheets in a timely manner sufficiently in advance to give ample time for reviewing, correcting, resubmitting and re-reviewing if necessary. No claim for delay will be granted for failure to comply with this requirement.

- K. Equipment shall be of proper size for its allotted space. Equipment may be disassembled as required, where it does not invalidate the manufacturer's warranty, so that it can be installed through available window door, or louver openings.
- L. Schedule of Shutdowns: After the project construction schedule is developed, submit the following information to the Owner for all required shutdowns of existing systems.
 - 1. Date of proposed shutdown.
 - 2. List of systems to be affected.
 - 3. List of areas affected by the shutdown.
 - 4. Description of work to be performed.
 - 5. Estimated length of the shutdown.
- M. Piping Systems Schedule: Prepare and submit a schedule of HVAC piping systems to indicate the piping material, joints, and fittings to be used with each system.
- N. Insulation Schedule: Prepare and submit a schedule to indicate insulation types and thicknesses to be used on each HVAC piping system.
- O. UL Through-Penetration Firestop System Schedule: Prepare and submit a schedule to indicate the UL-System number for through-penetration assemblies to be used with all mechanical systems. Coordinate with the work of the Penetrations and Fire Stopping Section in Division 7.
- P. Shop Drawings: Submit product data sheets and shop drawings as specified within the HVAC Sections of Division 23.
- Q. Record Drawings: Prepare record drawings in accordance with the provisions of Division 1 governing - Project Record Documents and the additional requirements of this Section.
- R. Operation and Maintenance Manuals: Prepare and submit copies of the Operation and Maintenance Manuals as specified in the appropriate Section of Division 1 governing - Contract Close-out the additional requirements of this Section.
- S. Training Seminar Confirmation: Prior to the final completion of the project, submit copies of the training seminar sign in sheets and a letter to the Owner containing the names of training seminar participants, including instructor's

names, the name of the firms represented and the dates of the instruction seminars.

- T. Engineer's Action: Except for items submitted solely for record purposes or information, the Engineer will review each submittal for general compliance with the Contract Documents, as defined in the General Conditions, and return the submittal with comments.
- U. Action Stamp: The Engineer will attach a Submittal Review sheet to each submittal package to indicate the status of the submission and the action taken, as follows:
 - 1. Furnish as Submitted: Submission is generally in compliance with the intent of the contract documents and fabrication may be undertaken.
 - 2. Furnish as Noted: Submission is generally in compliance with the contract documents and fabrication may be undertaken with the corrections noted.
 - 3. Revise and Resubmit: Submission is not in compliance with the contract documents and requires substantial corrections. Fabrication work may not be undertaken.
 - 4. Rejected: Submission is not in compliance with the contract documents. Resubmit as specified.
 - 5. Submit Specified Item: Second submission is not in compliance with the contract documents. Submit specified item without deviation.
 - 6. Reviewed for Comment Only: Engineer is not responsible for the approval of the submittal.

1.5 QUALITY ASSURANCE:

- A. Qualifications: Use adequate numbers of skilled, licensed workers who are thoroughly trained and experienced and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Standard of Quality: The manufacturers names specified first or scheduled on the drawings are used for the design and to establish the standards of function, dimension, space requirements, appearance, and quality upon which the Contract is based. Acceptable manufacturers' names are listed to provide competitive bids with the specified or scheduled manufacturer.
 - 1. Acceptable Manufacturers: The inclusion of a manufacturer's name within the list of acceptable manufacturers does not necessarily mean that

the manufacturer's standard product is equal to the specified or scheduled product without some required modification. The submitted product shall be equal in terms of quality, durability, appearance, space requirements, weight, strength, and design to the product required by the Contract Documents.

C. Contractor's Review: It is solely the Contractor's responsibility to verify that the products of acceptable manufacturers and proposed substitutes meet or exceed the performance of the specified or scheduled product. To be considered acceptable, products must comply with the following for the full possible performance range:

1. Horsepower: Equal or less.
2. Efficiency: Equal or greater.
3. Capacities: Equal or greater.
4. Space/Clearances: Equal or greater.
5. Storage and Recovery: Equal or greater.
6. Warranty: Equal or better.
7. Weight: Equal or less.
8. Noise: Equal or quieter.

D. Substitutions: Substitutions include manufacturers not listed as acceptable within the specifications, or products, systems and methods, which differ from the specified systems.

1. Comply with the provisions of the Instructions to Bidders and pertinent sections in Division 1. Submit list of proposed substitutes for review and approval in compliance with the Instructions to Bidders, AIA Document A701.
2. By the submission of a proposed substitution, the Contractor represents that he has reviewed the proposed substitution and certifies that:
 - A. The proposed substitution does not affect dimensions shown on drawings.
 - B. Changes to the building design, including A/E design and review time at a rate of 2.6 x DPE, detailing and construction costs caused by the requested substitution will be included in the bid price with no additional cost to the Owner.
 - C. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
 - D. Maintenance and service parts are available locally.

E. All costs associated with or caused by the use of the proposed substitute will be covered by the Contractor.

E. Codes and Regulations:

1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies and authorities that have jurisdiction.
2. In case of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern.

F. Qualifications for Welding and Brazing Work:

1. Qualify welding processes and welding operators in accordance with AWS Standard Qualification Procedure."
2. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
 - A. If recertification of welders is required, retesting will be Contractor's responsibility.

1.6 DELIVERY, STORAGE, AND HANDLING:

- A. Protection: Use all means necessary to protect materials of the Mechanical Sections before, during and after installation and to protect installed work and materials of all trades and Sections.
- B. Replacements: In the event of damage, immediately make all repairs and replacement necessary to the approval of the Engineer at no change in Contract Sum.

1.7 PROJECT CONDITIONS:

- A. Comply with Article 2 of the Instructions to Bidders, AIA Document A701, including the Appendix. Visit the site prior to submission of bids and examine existing conditions to be familiar with the related implications to the Work of the HVAC Sections.
 1. Questions regarding the Bidding Documents: Submit questions and requests for clarifications in compliance with the Instructions to Bidders.
- B. Contract Documents: The Contract Drawings are diagrammatic and do not show every fitting and component and shall be used in conjunction with the specified requirements to provide complete and fully functional systems for the intended

use. The drawings and specifications are complimentary, and the requirements indicated on both establish the requirements of the Contract.

1. The Contract Drawings indicate the general locations of equipment and distribution systems throughout the project. The actual installation locations shall be coordinated by the contractor on site based on actual field measurements performed by the contractor.
- C. Document Review: Review the complete set of Contract Documents and be familiar with the space requirements and work of other Sections. Thoroughly review building sections, architectural details, space availability phasing requirements and mechanical drawings for a complete understanding of the scope and coordination requirements of the HVAC Sections.
 - D. Scheduled Equipment: Standard manufacturers model numbers scheduled on the drawings shall be modified as specified in the descriptive specification for the scheduled equipment. The drawings generally define quantities, and the specifications further define equipment quality and system components, which may not be included in the standard model number.
 - E. Pipe sizing notations: Pipe sizing notations run along the pipe from the larger sizes to the smaller size. Sections of pipe, which are not specifically identified with a pipe size, are the continuation of the previous larger pipe size indication. Pipe sizes change only where indicated by a notation change.
 - F. Existing Conditions: The existing conditions indicated on the contract drawings are taken primarily from existing record drawings provided by the Owner and do not necessarily indicate actual as-built conditions. Preparation work of the mechanical and electrical sections includes the verification of existing conditions before the start of related installation work.

1.8 WARRANTY:

- A. Upon completion of the Work and as a condition of its acceptance and final payment, deliver to the Architect five (5) copies of a written Warranty agreeing to replace the work of Division 23, which fails due to defective materials or workmanship within one year after Date of Substantial Completion as that date is determined in accordance with the General Conditions. All refrigeration compressors shall have the manufacturer's extended warranty for a total of five (5) years.
- B. Failure due to defective materials or workmanship is deemed to include, but is not to be limited to:
 1. Failures in operating component or components.

2. Code violations.
- C. Obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.
- D. Replace material and equipment that require excessive service during warranty period as defined and as directed by Architect.
- E. Warranty shall include 24-hour service of complete system during warranty period at no cost to Owner. Choice of service organization shall be subject to Owner's approval.
- F. Include copy of warranty in the Operation and Maintenance Manuals.
- G. At end of warranty period, transfer manufacturer's equipment and material warranties still in force to Owner.
- H. This Article shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

1.9 MANUALS AND INSTRUCTIONS:

- A. Comply with pertinent provisions of the appropriate Section in Division 1 regarding - Contract Closeout.
- B. Operation and Maintenance Manuals: Bind Manuals in commercial quality, 8-1/2 x 11 inch three-ring binders with hardback washable, plastic cover, and provide identified dividers with tabs. Indicate appropriate model numbers in manufacturers' brochures and cross out non-applicable information. Review the Manuals with the Owner's maintenance personnel and add additional maintenance data sheets and information as directed by the Owner's Representatives. Copies of faxed pages are unacceptable.
 1. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in coordinated manuals with additional information describing combined operation of field-assembled units, including as-built wiring diagrams. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment.
 2. Provide directions for and sequences of operation for HVAC systems of Division 23. Sequence shall list valves, switches, and other devices used to start, stop and control systems.
 3. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment. Include

additional instructions necessary for implementation of first-class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.

- C. Furnish three (3) copies of manuals to Architect for approval and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.
- D. Organization of Manuals: Divide manuals with identified tabs to match the mechanical and electrical specification sections numbers and titles. Separate product information within each section by the Article numbers and titles as listed in Part 2 of each specification section. Provide a clear see-through plastic holder on the edge of the binder with a typed card indicating the Project name, the Engineer's name, the Installer's name and the Volume number (e.g., Vol. No. 1 of 2).
- E. Manuals shall include the following materials and information for all specified materials and equipment:
 - 1. Table of contents.
 - 2. Emergency instructions with 24-hour phone number to contact a responsible individual for each Section of Work.
 - 3. Subcontractor's warranties.
 - 4. Name and telephone number of local representative and supplier.
 - 5. Manufacturers' maintenance procedures.
 - 6. Exploded drawings and parts lists.
 - 7. Troubleshooting checklists with potential problems and possible causes.
 - 8. Schematic wiring diagrams.
 - 9. Record drawings.
 - 10. Equipment warranties and guaranties.
 - 11. Sequence of Operations and Systems Descriptions.
 - 12. Additional requirements specified in other sections.

- F. Maintenance Information: Systems which require preventive maintenance to maintain efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions, as specified by the manufacturer, shall be stated clearly and incorporated on a readily accessible label on the equipment. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

- G. Instruction Seminars: Perform systems instruction seminars and walk-through with the Owner's designated representatives after preparation, review and approval of the Operation and Maintenance manuals by the Architect and Owner.
 - 1. Record the names and firms represented of all training seminar participants, including all instructors and manufacturers representatives on a seminar sign in sheet.
 - 2. During the instruction period the Operation and Maintenance Manual shall be used and explained.

- H. As a minimum training sessions shall consist of the following:
 - 1. General project information and review shall be by the General Foreman or Superintendent of the Trade.
 - 2. Specific system and equipment training shall be by a Factory Trained Representative.
 - 3. Provide a complete review of the project and systems including, but not limited to, the following:
 - A. In a classroom environment mount the drawings on an easel or equivalent and review each Record Drawing (can use typical).
 - B. Note equipment layouts, locations and control points.
 - C. Review each system.
 - D. Review system design operation and philosophy.
 - E. Review alarms and necessary responses.
 - F. Review areas served by various equipment and systems.
 - G. Identify color codes used.

- H. Review features and special functions.
 - I. Review maintenance requirements.
 - J. Review operation and maintenance manuals.
 - K. Respond to questions. Record questions and answers.
4. After classroom training, walk the entire project, review each equipment room and typical locations. Explain equipment and proper operation.

1.10 RECORD DOCUMENTS:

- A. Prepare record documents for the work of Division 23 as specified in Division 1 for Project Record Documents. The record drawings shall accurately indicate all valve locations and shall clearly show the assigned valve tag number. Record drawings shall include:
 - 1. Piping and equipment location changes from the Contract Documents.
 - 2. Updated schedules to indicate the scheduled characteristics of the actual installed equipment.
 - 3. Equipment identification numbers coordinated with the Owner's Facility Management Program.
 - 4. Locations of seismic restraints.
- B. Record drawings include ductwork, sprinkler and fabrication drawings required for all other systems and coordination drawings prepared under the work of this contract. Provide polyester mylar reproducible drawings and electronic AutoCAD or Revit files of both the contract drawings and additional fabrication/coordination drawings that indicate mechanical and electrical systems. All electronic files shall be fully bound and submitted on CD format.

1.11 ELECTRONIC DRAWING FILES:

- A. Electronic drawing files of floor plans and schedules on AutoCAD, Revit, or DXF format will be made available by the Engineer for the Contractor's use to prepare fabrication, coordination or record drawings. After the Contractor requests the electronic files, a waiver will be provided for the Contractor to sign and return to Weston & Sampson Engineers, Inc. A service charge of one hundred dollars (\$100.00) per disc will be charged to cover the cost of the Engineer's time and materials. After Weston & Sampson Engineers, Inc. receives the signed waiver the electronic drawing files will be forwarded to the Contractor.

1.12 HVAC/ELECTRICAL SCOPE DELINIATIONS

- A. Unless otherwise called out in the plans and specifications, HVAC/Electrical coordination shall be:
1. Motors. Division 23 - HVAC shall provide motors for all HVAC equipment and shall be provided by the specific equipment manufacturer. All motors provided by Division 23 - HVAC shall conform to the requirements of Section 23 05 13 Common Motor Requirements for HVAC Equipment. Motors for Division 23 shall be Premium Efficiency.
 2. Motor Starters not located in a Motor Control Center (MCC). Division 23-HVAC shall provide motor starters for all HVAC equipment that is not controlled by a Motor Starter located in an MCC or by a VFD. Whenever possible Motor Starters shall be factory mounted and wired. For Motor Controllers that are remotely located, Division 26 shall wire the motor to the Motor Starter. All Motor Starters provided by Division 23 – HVAC shall conform to the requirements of Section 26 29 13 - Manual and Magnetic Motor Controllers
 3. Motor Starters and Variable Frequency Drives (VFDs) located in MCCs. Division 26 shall provide all Motor Starters and VFDs that are located in an MCC.
 4. Variable Frequency Drives (VFDs) not located in an MCC. Division 23-HVAC shall provide VFDs for motors as called out in the HVAC schedules. Whenever possible VFDs shall be factory mounted and wired. For motors that are remotely located, Division 26 shall wire the motor to the VFD. All VFDs provided by Division 23 – HVAC shall conform to the requirements of Section 26 29 23 - Variable Frequency Motor Controllers

PART 2 - PRODUCTS

2.1 PRESSURE VESSELS:

- A. Pressure vessels including provided under Division 23 shall be ASME rated construction.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Inspect site conditions before starting preparatory work and verify that actual conditions are known and acceptable before starting work. Be familiar with the work of other sections, separate contractors, and the Owner.

- B. Inspect areas where piping, conduit, ductwork, fixtures and equipment will be installed and verify adequate space is available for access, service and removal of equipment. Coordinate with the Work of other Sections.

3.2 PREPARATION:

- A. Perform coordination with the work of other Sections and prepare composite coordination drawings as specified in this Section before starting installation work of Division 23.

3.3 LIFE SAFETY SYSTEMS SHUTDOWNS:

- A. Maintain the existing Life Safety Systems in operation during construction and obtain impairment permits from the local Authorities Having Jurisdiction for all Life Safety Systems affected by the work of Division 23.
- B. Safeguarding Construction: Provide fire watch, portable extinguishers, and safety procedures in compliance with NFPA 241.

3.4 CORE DRILLING:

- A. Do not core new concrete structure without written approval from the Engineer.
- B. Perform all core drilling required for the proper installation of the work of Division 23. Locate all required openings and prior to coring coordinate the opening with the other Trades and obtain approval from the Engineer.
- C. Thoroughly investigate the existing conditions in the vicinity of the required opening prior to cutting. Take care so as not to disturb the existing building systems. Damage to existing conditions incurred during core drilling shall be corrected to the Owners satisfaction with no additional expense to the Owner.

3.5 CUTTING AND PATCHING:

- A. Cutting and patching shall be performed under other Sections. Locate all other than cored openings required for the installation of the mechanical piping systems. Coordinate the opening with the work of the other trades so as not to interfere with the work of other Sections. Thoroughly investigate the existing conditions in the vicinity of the required openings as much as possible.
- B. Patching of the existing walls around openings shall be performed by the respective trade responsible for the finish material in which the opening is made.

3.6 GENERAL INSTALLATION REQUIREMENTS

- A. General: Coordinate with the work of other trades before starting installation. Install materials and equipment in accordance with the Manufacturers latest printed installation instructions and the product NRTL listing requirements.
1. Install systems as high as possible to maximize ceiling heights.
 2. Install equipment with care to minimize damage to shop applied finishes. Replace or repair damaged components or finishes incurred during shipping and installation to the Owners satisfaction.
 3. Thoroughly clean items before installation. Cap pipe openings to exclude dirt until fixtures are installed and final connections have been made.
 4. Show no tool marks or threads on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.
 5. Make changes in directions with fittings, make changes in main sizes with eccentric reducing fittings.
 6. Install equipment and components to minimize noise and vibration transmission to the structure. Provide vibration isolators and flexible connectors for all vibrating equipment.
 7. Securely bolt all equipment, isolators, hangers, and similar items in place.
 8. Provide complete dielectric isolation between ferrous and non-ferrous metals.
 9. Provide Armstrong Armaflex 2000 white insulation on duct hangers, duct flanges, the edge of ductwork, and to the sharp edges of mechanical systems when located below 6'-8" above the floor.
- B. Equipment Access for Maintenance and Removal:
1. Install equipment and accessories to permit access for maintenance as specified by the equipment manufacturer. Provide adequate clearance to disconnect equipment for removal. Locate valves and unions so additional piping removal is not necessary to remove equipment. Coordinate equipment locations with all trades to ensure adequate clearance is maintained for equipment maintenance and removal.
 2. Relocate items as necessary to provide access for maintenance and removal without additional cost to the Owner.

3.7 FIRE WATCH:

- A. Provide a fire watch as required by Division 1 when performing work, which may cause a fire, such as welding or torch cutting work.

3.8 SCAFFOLDING, HOISTING, RIGGING AND STAGING

- A. Provide scaffolding, hoisting, rigging, conveyance apparatus and staging in conformance with Division 1 as required to perform the work specified in the other mechanical sections of Division 23.

3.9 RECORD DOCUMENTS:

- A. Project Progress and Record Drawings: Comply with the appropriate Section of Division 1 governing Project Record Documents and the additional requirements of this Section.
 - 1. Maintain a daily record of the project construction progress by coloring the work completed on the white prints furnished by the Owner at the commencement of the work.
 - 2. Modify the equipment schedules to reflect data consistent with that of the installed equipment. Clearly show all changes to the work as a result of addenda, change orders, clarifications, instructions issued by the Architect or conditions encountered in the field. Accurately indicate the location, size, type and elevation of new work and their relationship to existing work. Provide dimensions from permanent site improvements or column centerlines.
 - 3. The marked up and colored in prints will be used as a guide for determining the progress of the work installed. They shall be inspected weekly and shall be corrected immediately if found inaccurate or incomplete. Requisitions for Payment will not be approved until the Drawings are accurate and up to date.
- B. At the completion of the work submit one set of the marked-up prints for review and acceptance. After acceptance, these marked up record prints shall be used to prepare the Owner's final Record Drawings.
- C. Maintain the established layering, color and pen thickness scheme on modified electronic drawing files.

- D. Make all modifications on the AutoCAD or Revit files indicated on the approved marked up set of Record Drawings. Remove all superseded data to show the completed installation.
- E. The final approved AutoCAD or Revit Record Drawing files shall become the property of the Owner.
- F. Deliver the completed Record Documents properly titled and dated to the Architect. These Record Documents shall become the property of the Owner.

3.10 SYSTEM START-UPS AND INSTRUCTIONS:

- A. Start-Ups: Perform system and equipment start-ups in accordance with the manufacturers' printed start-up instructions in the presence of the manufacturers' representatives.
 - 1. Perform initial systems start up for all Life Safety Systems with the manufacturers' representatives and provide complete integrated systems testing and verification as detailed in the Fire Protection Narrative before notifying the approving Authorities having Jurisdiction. Make all necessary adjustments, corrections and changes and retest the systems with the manufacturers' representatives present during the final testing and preliminary acceptance tests.
 - 2. After the successful completion of all preliminary Life Safety Systems acceptance tests notify the approving Authorities having Jurisdiction.
 - 3. Perform the final Life Safety Systems acceptance tests as detailed in the Fire Protection Narrative with the Manufacturers' Representatives, Authorities having Jurisdiction and Owner's Maintenance and Facility staff in attendance.

3.11 COMMISSIONING REQUIREMENTS:

- A. Systems furnished, installed and/or provided by Division 23 will be commissioned in accordance with IECC 2018.
- B. Contractor shall provide the services of the Testing and Balancing subcontractor, the Building Controls subcontractor, Equipment Manufacturers' representatives, and his own personnel as required to operate, adjust, and calibrate equipment and systems and assist the Commissioning Agent in performing the services as specified in Section 23 80 00 Commissioning of HVAC.

3.12 ADDITIONAL REQUIREMENTS FOR THE COMPLETION OF THE PROJECT:

**OPERATIONS & MAINTENANCE MANUALS CHECK LIST & SIGN OF
COVER SHEET**

	INITIAL
All O&M's shall be assembled with dividers with tabs.	
Dividers for equipment shall be sorted by Section Number.	
O&M manuals shall include the following:	
Table of Contents	
Warranties (including subcontractors)	
Contractor contact list, normal & emergency	
Vendor contact list	
1-year chemical treatment (only water systems)	
Valve tag chart	
Boiler inspection (if OWNER's insurance or state requires)	
All equipment in project	
Record drawings including the following:	
All ductwork, piping, and equipment location changes from the contract documents	
Updated schedules of actual equipment installed if different from contract documents	
Valve locations and valve tag numbers	
Equipment identification numbers	
Seismic restraint locations	

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Related Sections: See section 230050.

1.2 SUMMARY:

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Open-spring isolators.
4. Elastomeric hangers.
5. Spring hangers.
6. Snubbers.
7. Mechanical anchor bolts.

1.3 ACTION SUBMITTALS:

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
 1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS:

- A. Welding certificates.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE:

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS:

- A. Elastomeric Isolation Pads:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mason Industries, Inc.
 - b. Novia; A Division of C&P.
 - c. Vibration Mountings & Controls, Inc.
 - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 3. Size: Factory or field cut to match requirements of supported equipment.
 - 4. Pad Material: Oil and water resistant with elastomeric properties.
 - 5. Surface Pattern: Waffle pattern.
 - 6. Infused nonwoven cotton or synthetic fibers.
 - 7. Load-bearing metal plates adhered to pads.

2.2 ELASTOMERIC ISOLATION MOUNTS:

- A. Double-Deflection, Elastomeric Isolation Mounts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Mason Industries, Inc.](#)
 - b. [Novia; A Division of C&P.](#)
 - c. [Vibration Mountings & Controls, Inc.](#)
2. Mounting Plates:
- a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 OPEN-SPRING ISOLATORS:

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - a. [Mason Industries, Inc.](#)
 - b. [Novia; A Division of C&P.](#)
 - c. [Vibration Mountings & Controls, Inc.](#)
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.4 ELASTOMERIC HANGERS:

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - a. [Mason Industries, Inc.](#)
 - b. [Novia; A Division of C&P.](#)

- c. [Vibration Mountings & Controls, Inc.](#)
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.5 SPRING HANGERS:

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - a. [Mason Industries, Inc.](#)
 - b. [Novia; A Division of C&P.](#)
 - c. [Vibration Mountings & Controls, Inc.](#)
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.6 SNUBBERS:

A. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:

1. [Mason Industries, Inc.](#)
2. [Novia; A Division of C&P.](#)

3. [Vibration Mountings & Controls, Inc.](#)
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

PART 3 - EXECUTION

3.1 APPLICATIONS:

- A. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION:

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 – CAST-IN-PLACE CONCRETE.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 07 72 00 – ROOF ACCESSORIES for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125-inch.
 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Install cables so they do not bend across edges of adjacent equipment or building structure.

- F. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- J. Drilled-in Anchors:
 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION:

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 23 21 13 – HYDRONIC PIPING for piping flexible connections.

3.4 FIELD QUALITY CONTROL:

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 ADJUSTING:

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections: See Section References for each Division in Section 23 00 50

1.2 SUMMARY:

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Duct labels.
 - 4. Miscellaneous Signage
 - 5. Warning tags.

1.3 ACTION SUBMITTALS:

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS:

- A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Seton Identification Products; a Brady Corporation company.
 - d. Or equal
 2. Material and Thickness: Multilayer, multicolor, phenolic plastic labels for mechanical engraving, 1/16-inch thick and having predrilled holes for attachment hardware.
 3. Letter Color: White.
 4. Background Color: Black.
 5. Maximum Temperature: Able to withstand temperatures up to 200 deg F.
 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2-inch by 3/4-inch.
 7. Minimum Letter Size: 1/2-inch for name of units if viewing distance is less than 24-inches, 3/4-inch for viewing distances up to 72-inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 8. Fasteners: Stainless-steel rivets or self-tapping screws.
 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number.
- C. Miscellaneous Labels (per drawings):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Seton Identification Products; a Brady Corporation company.
 - d. Or equal
 2. Material and Thickness: Multilayer, multicolor, phenolic plastic labels for mechanical engraving, 1/16-inch thick and having predrilled holes for attachment hardware.
 3. Letter Color: White.
 4. Background Color: Black.
 5. Maximum Temperature: Able to withstand temperatures up to 200 deg F.
 6. Label Size: Length and width vary for required label content, but not less than 2-1/2-inch by 3/4-inch.
 7. Minimum Letter Size: 1/2-inch for name of units if viewing distance is less than 24-inches, 3/4-inch for viewing distances up to 72-inches, and proportionately

larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 WARNING SIGNS AND LABELS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch thick and having predrilled holes for attachment hardware.
- C. Letter Color: White.
- D. Background Color: Red.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2-inch by 3/4-inch.
- G. Minimum Letter Size: 1/4-inch for name of units if viewing distance is less than 24-inches, 1/2-inch for viewing distances up to 72-inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 DUCT LABELS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Seton Identification Products; a Brady Corporation company.

4. Or equal
- B. General Requirements for Manufactured Duct Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Self-Adhesive Duct Labels: Printed plastic with contact-type, pressure sensitive, permanent-adhesive backing.
- D. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; prefix the system with the associated equipment number and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: Size letters according to ASME A13.1 for ductwork.

2.4 WARNING TAGS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Seton Identification Products; a Brady Corporation company.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 1. Size: Approximately 4-inches by 7-inches.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Clean piping and equipment surfaces, of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS:

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Identify air handling units with plastic nameplates.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Identify air terminal units' valves with numbered tags.
- J. Tag automatic controls, instruments, and relays. Key to control schematic.
- K. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 EQUIPMENT LABEL INSTALLATION:

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Equipment marking shall be prominently located and securely attached with screws or rivets (no adhesives or cements are permitted) on the normally visible side of the equipment.

3.4 DUCT LABEL INSTALLATION:

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Duct Label Locations: Locate duct labels where duct is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each duct at branch.
2. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
3. At access doors, manholes, and similar access points that permit view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced at maximum intervals of 20 feet along each run. Increase intervals to 50-feet in areas of long runs or uncongested ductwork and equipment.

3.5 WARNING-TAG AND LABEL INSTALLATION:

- A. Write required message on, and attach warning tags and/or labels to, equipment and other items where required.

END OF SECTION

SECTION 23 31 10

DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Sheet metal ducts:
 - a. Single-wall rectangular ducts and fittings.
 - b. Sheet metal materials.
 - c. Sheet metal sealants and gaskets.
 - d. Sheet metal hangers and supports.
- 2. Air Duct Accessories:
 - a. Backdraft dampers.
 - b. Manual volume dampers.
 - c. Control dampers.
 - d. Flange connectors.
 - e. Duct-mounted access doors.
 - f. Flexible connectors.
 - g. Duct accessory hardware.

- A. Related Sections: Related Sections: See section 230050.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:

- 1. Adhesives.
- 2. Sealants and gaskets.
- 3. Flexible ducts.

- B. Shop Drawings: For ductwork and accessories. Include plans, elevations, sections, details, and attachments to other work.

- 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
- 2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated, smoke-rated, and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers and access doors and panels.
12. Include plans showing locations and mounting and attachment details.
13. Hangers and supports, including methods for duct and building attachment and vibration isolation.
14. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Duct security bars.
 - f. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal:

1. Duct material and thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Seismic Qualification Data: Certificates, for nonmetal ducts, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Welding certificates.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

1.7 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SHEET METAL DUCTS

A. PERFORMANCE REQUIREMENTS

1. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
2. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
3. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
4. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
5. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

B. SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

1. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
2. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. For ducts with longest side less than 36-inches, select joint types in accordance with Figure 2-1.
 - b. For ducts with longest side 36-inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
 - c. Where specified for specific applications, all joints shall be welded.
3. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
4. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. SHEET METAL MATERIALS

1. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
2. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - a. Galvanized Coating Designation: G90.
 - b. Finishes for Surfaces Exposed to View: Mill phosphatized.
3. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
 - a. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

4. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36-inches or less; 3/8-inch-minimum diameter for lengths longer than 36-inches.

D. SHEET METAL SEALANT AND GASKETS

1. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
2. Two-Part Tape Sealing System:
 - a. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - b. Tape Width: 4-inches.
 - c. Sealant: Modified styrene acrylic.
 - d. Water resistant.
 - e. Mold and mildew resistant.
 - f. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - g. Service: Indoor and outdoor.
 - h. Service Temperature: Minus 40 to plus 200 deg F.
 - i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - j. Sealant shall have a VOC content of 420 g/L or less.
 - k. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Water-Based Joint and Seam Sealant:
 - a. Application Method: Brush on.
 - b. Solids Content: Minimum 65 percent.
 - c. Shore A Hardness: Minimum 20.
 - d. Water resistant.
 - e. Mold and mildew resistant.
 - f. VOC: Maximum 75 g/L (less water).
 - g. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - h. Service: Indoor or outdoor.
 - i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
4. Solvent-Based Joint and Seam Sealant:
 - a. Application Method: Brush on.
 - b. Base: Synthetic rubber resin.
 - c. Solvent: Toluene and heptane.
 - d. Solids Content: Minimum 60 percent.
 - e. Shore A Hardness: Minimum 60.
 - f. Water resistant.

- g. Mold and mildew resistant.
 - h. Sealant shall have a VOC content of 420 g/L or less.
 - i. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - j. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 - k. Service: Indoor or outdoor.
 - l. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
5. Flanged Joint Sealant: Comply with ASTM C920.
- a. General: Single-component, acid-curing, silicone, elastomeric.
 - b. Type: S.
 - c. Grade: NS.
 - d. Class: 25.
 - e. Use: O.
 - f. Sealant shall have a VOC content of 420 g/L or less.
 - g. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
6. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
7. Round Duct Joint O-Ring Seals:
- a. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - b. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - c. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

E. SHEET METAL HANGERS AND SUPPORTS

- 1. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- 2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- 3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- 4. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- 5. Trapeze and Riser Supports:

- a. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
- b. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
- c. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.2 AIR DUCT ACCESSORIES

A. ASSEMBLY DESCRIPTION

1. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
2. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. MATERIALS

1. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - a. Galvanized Coating Designation: G90.
 - b. Exposed-Surface Finish: Mill phosphatized.
2. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
3. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
4. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
5. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
6. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

C. BACKDRAFT DAMPERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating; a Mestek Architectural Group company.
 - b. Cesco Products; a division of MESTEK, Inc.
 - c. Flex-Tek Group.
 - d. Greenheck Fan Corporation.

- e. [Lloyd Industries, Inc.](#)
 - f. [Nailor Industries Inc.](#)
 - g. [NCA Manufacturing, Inc.](#)
 - h. [Pottorff.](#)
 - i. [Ruskin Company.](#)
 - j. [Safe Air - Dowco Products.](#)
 - k. [United Enertech.](#)
 - l. [Vent Products Co., Inc.](#)
2. Description: Gravity balanced.
 3. Maximum Air Velocity: 2000 fpm.
 4. Maximum System Pressure: 2-inch wg.
 5. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
 6. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
 7. Blade Action: Parallel.
 8. Blade Seals: Extruded vinyl, mechanically locked.
 9. Blade Axles:
 - a. Material: Galvanized steel.
 - b. Diameter: 0.20-inch.
 10. Tie Bars and Brackets: Galvanized steel.
 11. Return Spring: Adjustable tension.
 12. Bearings: Steel ball or synthetic pivot bushings.
 13. Accessories:
 - a. Adjustment device to permit setting for varying differential static pressure.
 - b. Counterweights and spring-assist kits for vertical airflow installations.
 - c. Electric actuators.
 - d. Chain pulls.
 - e. Screen Mounting: Front mounted in sleeve.
 - 1) Sleeve Thickness: 20 gage minimum.
 - 2) Sleeve Length: 6-inches minimum.
 - f. Screen Mounting: Rear mounted.
 - g. Screen Material: Aluminum.
 - h. Screen Type: Bird.
 - i. 90-degree stops.

D. MANUAL VOLUME DAMPERS

1. Standard, Steel, Manual Volume Dampers:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Aire Technologies.
- 2) American Warming and Ventilating; a Mestek Architectural Group company.
- 3) Flexmaster U.S.A., Inc.
- 4) Flex-Tek Group.
- 5) McGill AirFlow LLC.
- 6) Nailor Industries Inc.
- 7) Pottorff.
- 8) Ruskin Company.
- 9) Safe Air - Dowco Products.
- 10) Trox USA Inc.
- 11) United Enertech.
- 12) Vent Products Co., Inc.

b. Standard leakage rating.

c. Suitable for horizontal or vertical applications.

d. Frames:

- 1) Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
- 2) Mitered and welded corners.
- 3) Flanges for attaching to walls and flangeless frames for installing in ducts.

e. Blades:

- 1) Multiple or single blade.
- 2) Parallel- or opposed-blade design.
- 3) Stiffen damper blades for stability.
- 4) Galvanized-steel, 0.064-inch thick.

f. Blade Axles: Galvanized steel.

g. Bearings:

- 1) Molded synthetic.
- 2) Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

h. Tie Bars and Brackets: Galvanized steel.

2. Standard, Aluminum, Manual Volume Dampers:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) [American Warming and Ventilating; a Mestek Architectural Group company.](#)
 - 2) [McGill AirFlow LLC.](#)
 - 3) [Nailor Industries Inc.](#)
 - 4) [Pottorff.](#)
 - 5) [Ruskin Company.](#)
 - 6) [Safe Air - Dowco Products.](#)
 - 7) [Trox USA Inc.](#)
 - 8) [United Enertech.](#)
 - 9) [Vent Products Co., Inc.](#)
- b. Standard leakage rating.
- c. Suitable for horizontal or vertical applications.
- d. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
- e. Blades:
- 1) Multiple or single blade.
 - 2) Parallel- or opposed-blade design.
 - 3) Stiffen damper blades for stability.
 - 4) Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - 5) Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
- f. Blade Axles: Nonferrous metal.
- g. Bearings:
- 1) Molded synthetic.
 - 2) Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- h. Tie Bars and Brackets: Aluminum.
3. Jackshaft:
- a. Size: 1-inch diameter.
 - b. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - c. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
4. Damper Hardware:
- a. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - b. Include center hole to suit damper operating-rod size.
 - c. Include elevated platform for insulated duct mounting.

E. CONTROL DAMPERS

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:

- a. [American Warming and Ventilating; a Mestek Architectural Group company.](#)
 - b. [Arrow United Industries.](#)
 - c. [Cesco Products; a division of MESTEK, Inc.](#)
 - d. [Flex-Tek Group.](#)
 - e. [Greenheck Fan Corporation.](#)
 - f. [Lloyd Industries, Inc.](#)
 - g. [McGill AirFlow LLC.](#)
 - h. [Metal Form Manufacturing, Inc.](#)
 - i. [Nailor Industries Inc.](#)
 - j. [NCA Manufacturing, Inc.](#)
 - k. [Pottorff.](#)
 - l. [Ruskin Company.](#)
 - m. [Safe Air - Dowco Products.](#)
 - n. [United Enertech.](#)
 - o. [Vent Products Co., Inc.](#)
 - p. [Young Regulator Company.](#)
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 3. Frames:
 - a. U shaped.
 - b. 0.094-inch-thick, galvanized sheet steel.
 - c. Mitered and welded corners.
 4. Blades:
 - a. Multiple blade with maximum blade width of 8-inches.
 - b. Parallel- and opposed-blade design.
 - c. Galvanized-steel.
 - d. 0.064-inch thick single skin.
 - e. Blade Edging: Closed-cell neoprene.
 - f. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
 5. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - a. Operating Temperature Range: From minus 40 to plus 200 deg F.
 6. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - c. Thrust bearings at each end of every blade.

F. FLANGE CONNECTORS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CL WARD & Family Inc.
 - b. Ductmate Industries, Inc.
 - c. Elgen Manufacturing.
 - d. Hardcast, Inc.
 - e. Nexus PDQ.
 - f. Ward Industries; a brand of Hart & Cooley, Inc.
2. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
3. Material: Galvanized steel.
4. Gage and Shape: Match connecting ductwork.

G. DUCT-MOUNTED ACCESS DOORS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aire Technologies.
 - b. American Warming and Ventilating; a Mestek Architectural Group company.
 - c. Cesco Products; a division of MESTEK, Inc.
 - d. CL WARD & Family Inc.
 - e. Ductmate Industries, Inc.
 - f. Elgen Manufacturing.
 - g. Flexmaster U.S.A., Inc.
 - h. Greenheck Fan Corporation.
 - i. McGill AirFlow LLC.
 - j. Nailor Industries Inc.
 - k. Pottorff.
 - l. United Enertech.
 - m. Ventfabrics, Inc.
 - n. Ward Industries; a brand of Hart & Cooley, Inc.
2. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
 - a. Door:
 - 1) Double wall, rectangular.
 - 2) Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - 3) Vision panel.
 - 4) Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
 - 5) Fabricate doors airtight and suitable for duct pressure class.

- b. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - c. Number of Hinges and Locks:
 - 1) Access Doors Less Than 12-inches Square: No hinges and two sash locks.
 - 2) Access Doors up to 18-inches Square: Two hinges and two sash locks.
 - 3) Access Doors up to 24 by 48-inches: Three hinges and two compression latches with outside and inside handles.
 - 4) Access Doors Larger Than 24 by 48-inches: Four hinges and two compression latches with outside and inside handles.
3. Pressure Relief Access Door:
- a. Door and Frame Material: Galvanized sheet steel.
 - b. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
 - c. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 - d. Factory set at 10-inch wg.
 - e. Doors close when pressures are within set-point range.
 - f. Hinge: Continuous piano.
 - g. Latches: Cam.
 - h. Seal: Neoprene or foam rubber.
 - i. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

H. DUCT ACCESS PANEL ASSEMBLIES

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [3M](#).
 - b. [CL WARD & Family Inc.](#)
 - c. [Ductmate Industries, Inc.](#)
 - d. [Flame Gard, Inc.](#)
- 2. Labeled according to UL 1978 by an NRTL.
- 3. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- 4. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- 5. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- 6. Minimum Pressure Rating: 10-inch wg, positive or negative.

I. FLEXIBLE CONNECTORS

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [CL WARD & Family Inc.](#)
 - b. [Ductmate Industries, Inc.](#)
 - c. [Duro Dyne Inc.](#)
 - d. [Elgen Manufacturing.](#)
 - e. [Hardcast, Inc.](#)
 - f. [JP Lamborn Co.](#)
 - g. [Ventfabrics, Inc.](#)
 - h. [Ward Industries; a brand of Hart & Cooley, Inc.](#)
2. Materials: Flame-retardant or noncombustible fabrics.
 3. Coatings and Adhesives: Comply with UL 181, Class 1.
 4. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2-inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
 5. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - a. Minimum Weight: 26 oz./sq. yd..
 - b. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - c. Service Temperature: Minus 40 to plus 200 deg F.
 6. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 - a. Minimum Weight: 14 oz./sq. yd..
 - b. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 - c. Service Temperature: Minus 67 to plus 500 deg F.
 7. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - a. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - b. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - g. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

J. DUCT ACCESSORY HARDWARE

1. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
2. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 SHEET METAL DUCTS

A. DUCT INSTALLATION

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
2. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
3. Install ducts in maximum practical lengths with fewest possible joints.
4. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
5. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
6. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
7. Install ducts with a clearance of 1-inch, plus allowance for insulation thickness.
8. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
9. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2-inches.
10. Install heating coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
11. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines

for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

12. Elbows: Use long-radius elbows wherever they fit.
 - a. Fabricate 90-degree round elbows with a minimum of three segments for 12-inches and smaller and a minimum of five segments for 14-inches and larger.
13. Branch Connections: Use lateral or conical branch connections.

B. INSTALLATION OF EXPOSED DUCTWORK

1. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
2. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
3. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
4. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
5. Repair or replace damaged sections and finished work that does not comply with these requirements.

C. DUCT SEALING

1. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. HANGER AND SUPPORT INSTALLATION

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
2. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - a. Where practical, install concrete inserts before placing concrete.
 - b. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - c. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4-inches thick.
 - d. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4-inches thick.
 - e. Do not use powder-actuated concrete fasteners for seismic restraints.

3. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24-inches of each elbow and within 48-inches of each branch intersection.
4. Hangers Exposed to View: Threaded rod and angle or channel supports.
5. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
6. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

E. CONNECTIONS

1. Make connections to equipment with flexible connectors complying with the "Air Duct Accessories" section of this specification.
2. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

F. FIELD QUALITY CONTROL

1. Perform tests and inspections.
2. Duct System Cleanliness Tests:
 - a. Visually inspect duct system to ensure that no visible contaminants are present.
 - b. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - 1) Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
3. Duct system will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

G. DUCT CLEANING

1. Clean new duct system(s) before testing, adjusting, and balancing.
2. For cleaning of existing ductwork, see Section 23 01 30.52 "Existing HVAC Air Distribution System Cleaning."

3. Use duct cleaning methodology as indicated in NADCA ACR.
4. Use service openings for entry and inspection.
 - a. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
 - b. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - c. Remove and reinstall ceiling to gain access during the cleaning process.
5. Particulate Collection and Odor Control:
 - a. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - b. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
6. Clean the following components by removing surface contaminants and deposits:
 - a. Air outlets and inlets (registers, grilles, and diffusers).
 - b. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - c. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - d. Coils and related components.
 - e. Return-air ducts, dampers, and actuators, except in ceiling plenums and mechanical equipment rooms.
 - f. Supply-air ducts, dampers, and actuators.
 - g. Dedicated exhaust and ventilation components and makeup air systems.
7. Mechanical Cleaning Methodology:
 - a. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - b. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - c. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - d. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - e. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - f. Provide drainage and cleanup for wash-down procedures.

- g. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

H. STARTUP

- 1. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

I. DUCT SCHEDULE

- 1. Fabricate ducts as indicated in the following schedules and notes.
 - a. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
 - b. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- 2. Intermediate Reinforcement:
 - a. Galvanized-Steel Ducts: Galvanized steel.
- 3. Elbow Configuration:
 - a. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 4) Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - a) Radius-to Diameter Ratio: 1.5.
- 4. Branch Configuration:
 - a. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - 1) Rectangular Main to Rectangular Branch: 45-degree entry.
 - 2) Rectangular Main to Round Branch: Conical spin in.

3.2 AIR DUCT ACCESSORIES

A. INSTALLATION

1. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
2. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
3. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
4. Install volume dampers at points on supply, return, and exhaust systems at all branches. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - a. Install steel volume dampers in steel ducts.
 - b. Install aluminum volume dampers in aluminum ducts.
5. Set dampers to fully open position before testing, adjusting, and balancing.
6. Install test holes at fan inlets and outlets and elsewhere as indicated.
7. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - a. On both sides of duct coils.
 - b. Upstream from duct filters.
 - c. At outdoor-air intakes and mixed-air plenums.
 - d. At drain pans and seals.
 - e. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - f. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - g. At each change in direction and at maximum 50-foot spacing.
 - h. Upstream or downstream from duct silencers.
 - i. Control devices requiring inspection.
 - j. Elsewhere as indicated.
8. Install access doors with swing against duct static pressure.
9. Access Door Sizes:

- a. One-Hand or Inspection Access: 8 by 5-inches.
 - b. Two-Hand Access: 12 by 6-inches.
 - c. Head and Hand Access: 18 by 10-inches.
 - d. Head and Shoulders Access: 21 by 14-inches.
 - e. Body Access: 25 by 14-inches.
 - f. Body plus Ladder Access: 25 by 17-inches.
10. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
 11. Install flexible connectors to connect ducts to equipment.
 12. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
 13. Install duct test holes where required for testing and balancing purposes.
 14. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

B. FIELD QUALITY CONTROL

1. Tests and Inspections:
 - a. Operate dampers to verify full range of movement.
 - b. Inspect locations of access doors and verify that purpose of access door can be performed.
 - c. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

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. Propeller fans.

1.3 PERFORMANCE REQUIREMENTS:

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS:

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

- C. Delegated-Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS:

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS:

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION:

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 PROPELLER FANS:

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
 - 3. PennBarry; division of Air System Components.
- B. General Description: Fan arrangement shall be either supply or exhaust, see Fan Schedule
 - 1. Sidewall mounted applications
 - 2. Performance capabilities up to 78,600 cubic feet per minute (cfm) and static pressure to 3.4 inches of water gauge
 - 3. Fans are available in eight sizes with nominal propeller diameters ranging from 20 inches through 60 inches.
 - 4. Maximum continuous operating temperature 150° Fahrenheit with appropriate motor selection.
 - 5. Minimum continuous operating temperature -10° Fahrenheit.
 - 6. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual unit serial number.
- C. Propeller:
 - 1. Constructed of: Fabricated Steel
 - 2. Securely attached to motor shaft with a standard square key, set screw and tapered bushing
 - 3. Statically and dynamically balanced in accordance with AMCA Standard 204-05
 - 4. The propeller and fan inlet will be aligned and shall have precise running tolerances for maximum performance and operating efficiency.
 - 5. Propellers are not coated when fan coatings accessory is selected regardless of material type.
- D. Motors:

1. Electronically Commutated Motor
 - a. Motor enclosures: Open Drip-Proof
 - b. Electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors.
 - c. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
 - d. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor or integrated variable frequency drive.
 - e. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
 - f. Motors can achieve up to 95% efficiency (model and horsepower dependent).

E. Drive Frame:

1. Drive frames and fan panels shall be bolted construction.
2. Drive frame assemblies and fan panels shall be galvanized steel or painted steel.
3. Drive frame shall be formed steel and fan panels shall have pre-punched mounting holes, formed flanges, and a deep formed inserted venturi.

F. Disconnect Switches:

1. NEMA rated: 1.
2. Positive electrical shut-off.
3. Wired from fan motor to junction box.

G. Options/Accessories:

1. Dampers:
 - a. Type: Motorized
 - b. Prevents outside air from entering back into the building when fan is off.
 - c. Balanced for minimal resistance to flow.
 - d. Galvanized frames with pre-punched mounting holes.
2. Wall Housing:
 - a. Mounting arrangement: Flush Interior.
 - b. Constructed of galvanized steel or painted steel with heavy gauge mounting flanges and pre-punched mounting holes.
 - c. Housing shall include OSHA approved motor guard.
 - d. Reduces installation time and provides maximum installation flexibility.
3. Wall Collar:

- a. Constructed of galvanized steel or painted steel with heavy gauge mounting flanges and pre-punched mounting holes.
4. Motor Side Guard:
- a. Guard type: OSHA Guard.
 - b. Protective guard completely enclose the motor and drive side of the fan.

2.2 MOTORS:

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL:

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
 - 2. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."
- C. Install units with clearances for service and maintenance.

- D. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS:

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL:

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.

- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.4 ADJUSTING:

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION

SECTION 23 82 39

UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes cabinet unit heaters with centrifugal fans and electric-resistance heating coils, propeller unit heaters with electric-resistance heating coils, and wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS:

- A. CWP: Cold working pressure.
- B. DDC: Direct digital control.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS:

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include location and size of each field connection.
 - 4. Include details of anchorages and attachments to structure and to supported equipment.

5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 6. Indicate location and arrangement of piping valves and specialties.
 7. Indicate location and arrangement of integral controls.
 8. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.
- E. Samples for Verification: Finish colors for each type of cabinet unit heater indicated with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS:

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Structural members to which cabinet unit heaters will be attached.
 3. Method of attaching hangers to building structure.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 6. Perimeter moldings for exposed or partially exposed cabinets.
- B. Seismic Qualification Data: Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces defined in Section 23 05 48 "Vibration and Seismic Controls for HVAC." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Include detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For cabinet unit heaters, propeller unit heaters, wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. For propeller unit heaters - Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Marley
 - 2. Berko
 - 3. QMark
 - 4. Trane
 - 5. Modine

2.2 PERFORMANCE REQUIREMENTS:

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- C. Seismic Performance: Cabinet unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.3 DESCRIPTION – PROPELLER UNIT HEATERS:

- A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 2021.
- D. Comply with UL 823.

2.4 PERFORMANCE REQUIREMENTS:

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- C. Seismic Performance: Propeller unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.5 HOUSINGS:

- A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.6 COILS:

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16-inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
 - 1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 - 2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.7 FAN AND MOTOR:

- A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

2.8 CONTROLS:

- A. Control Devices:
 - 1. Wall-mounted, variable **fan**-speed switch.
 - 2. Wall-mounted thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and/or electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Install unit heaters to comply with NFPA 90A.
- B. Install unit heaters level and plumb.
- C. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 07 92 00 "Joint Sealants."
- D. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- E. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

- F. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- H. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS – PROPELLER UNIT HEATERS:

- A. Install piping adjacent to machine to allow service and maintenance.
- B. Comply with safety requirements in UL 1995.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL:

- A. Perform the following tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING:

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION

SECTION 26 00 50

ELECTRICAL WORK - GENERAL PROVISIONS

PART 1 – GENERAL

1.1 WORK INCLUDED:

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required to make ready for use the complete electrical systems as shown on the Drawings and as specified hereinafter.
- B. In conjunction with other sections of Division 26, the work shall include but not be limited to furnishing and installing the following:
 - 1. Electrical services
 - 2. Electrical raceway systems
 - 4. Wires and cables
 - 5. Panelboards
 - 6. Miscellaneous equipment
 - 7. Grounding systems
 - 8. Circuit breakers
 - 9. Motor Control Center
- C. Make all necessary connections at "packaged" equipment furnished under other sections and Divisions of these specifications.
- D. Make all connections to equipment and devices furnished under Division 26 and other sections of these specifications except as otherwise specified.
- E. Connect process and instrumentation cables furnished with field-mounted equipment under other sections and Divisions of these specifications.
- F. Mount all motor control equipment enclosures not factory mounted, unless otherwise indicated.
- G. It is the intent of these specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this section shall be furnished at no extra cost to the Owner.

1.2 RELATED WORK:

- A. The Contractor's attention is directed to the General Conditions, Supplementary Conditions.
 - B. Excavation and backfilling required for underground electrical work is included under Division 31.
 - C. Concrete work and reinforcing for electrical equipment pads is included under Division 3.
- 1.3 CODES, INSPECTIONS, PERMITS AND FEES:
- A. All material and installations shall be in accordance with the latest edition of the National Electrical Code and all applicable local codes and ordinances.
 - B. Obtain all necessary permits and pay all fees for permits and inspections.
- 1.4 INTERPRETATION OF DRAWINGS:
- A. The Drawings are not intended to show exact locations of conduit runs.
 - B. Each three-phase circuit shall be run in a separate conduit unless otherwise shown on the Drawings.
 - C. Unless otherwise noted and/or approved by the Engineer all conduits shall be installed concealed.
 - D. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.
 - E. Any work installed contrary to or without review by the Engineer shall be subject to change as required by the Engineer, and no extra compensation will be allowed for making these changes.
 - F. The locations of equipment, shown on the drawings are approximate only. Exact locations shall be as determined by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as required by the Engineer and furnish all labor and materials necessary to complete the work in an acceptable manner.
 - G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.

- H. All connections to equipment shall be made as required and in accordance with the approved shop and setting drawings.

1.5 SUBMITTALS:

In accordance with requirements of general specifications and section 01 33 23, submit the following:

- A. Complete shop drawings shall be submitted for but not limited to the following equipment: panelboards, fire alarm, service cabinets, load centers, conduit and wire.
- B. The manufacturer's name, product designation or catalog number, descriptive literature and data shall be submitted for the following material and equipment:
 - 1. Conduit
 - 2. Boxes and fittings
 - 3. Wires, cables and appurtenances
 - 4. Service cabinets
 - 5. Wiring devices and appurtenances
 - 6. Circuit breakers
 - 7. Panelboards
 - 8. Grounding Equipment
 - 9. Control devices and stations
- C. Prior to submittal, all shop drawings shall be checked for accuracy and conformance to contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to the specifications and drawings. This statement shall also list all discrepancies with the specifications and drawings. Shop drawings not so checked and noted shall be returned.
- D. The Engineer's review shall be only be for conformance with the design concept of the project and compliance with the specifications and drawings. The responsibility of, and the necessity of, furnishing materials and workmanship required by the specifications and drawings which may not be indicated on the shop drawings is included under the work of this section.
- E. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this section.

1.6 MANUFACTURER'S SERVICES:

Furnish manufacturer's services for testing and start-up when required.

1.7 ELECTRIC SERVICES:

- A. The electric utility serving this project is Eversource Electric.
- B. Service to building shall be as indicated on the plans.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. The materials used in all systems shall be new, unused and as hereinafter specified. All materials, where not specified, shall be of the very best of their respective kinds. Samples of materials or manufacturer's specifications shall be submitted for review as required by the Engineer.
- B. Materials and equipment used shall be Underwriters' Laboratories, Inc. listed.
- C. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of- doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as required by the Engineer or shall be replaced at no additional cost to the Owner.
- D. The Contractor's attention is directed to the requirements of the various sections of division 26 for additional product specifications.

2.2 MANUFACTURER'S NAMEPLATES:

- A. All equipment shall have the manufacturer's name, address, model or type designation, serial number and all applicable ratings clearly marked thereon in a location which can be readily observed after installation. The required information may be die-stamped into the surface of the equipment or may be marked on durable nameplates permanently fastened to the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Provide and place all sleeves for conduit penetrations through floors, walls, partitions, etc. Locate all necessary slots and inserts for electrical work and place in form before concrete is poured.

- B. Equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably to insure that the tilting does not impair the functional integrity of the equipment.

3.2 RECORD DRAWINGS:

As the work progresses, legibly record (red line) all field changes on a set of project contract drawings. Prior to Substantial Completion of the project, submit the red lined prints to the Engineer for use in preparation of the record drawings.

3.3 TESTS AND ADJUSTMENTS:

- A. Test all systems furnished under Division 26 and repair or replace all defective work. Make all necessary adjustments to the systems and equipment and instruct the Owner's personnel in the proper operation of the systems and equipment.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

- ###### A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- ###### A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- ###### A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

- ###### B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Okonite Company (The).
5. Southwire Company.
6. Approved equal.

- ###### C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. RoHS compliant.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
1. Type RHH and Type RHW-2: Comply with UL 44.
 2. Type THHN and Type THWN-2: Comply with UL 83.
 3. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alpha Wire Company.
 2. Belden Inc.
 3. Okonite Company (The).
 4. Southwire Company.
 5. Approved equal.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Comply with UL 1569.
 3. RoHS compliant.
 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
1. Single circuit.
 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

- F. Ground Conductor: Bare.
- G. Conductor Insulation:
 - 1. Type THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- H. Armor: Steel, interlocked.
- I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M Electrical Products.
 - 2. AFC Cable Systems; a part of Atkore International.
 - 3. Hubbell Power Systems, Inc.
 - 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 5. Thomas & Betts Corporation; A Member of the ABB Group.
 - 6. Approved equal.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One hole with standard barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls and Partitions dry spaces only: Metal-clad cable, Type MC.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions dry spaces only: Metal-clad cable, Type MC.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls and ceilings unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "HANGERS AND SUPPORT FOR ELECTRICAL SYSTEMS."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12-inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 FIRESTOPPING

- A. Apply fire stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly in accordance with manufacturers recommendations.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - a. Ground rods.
 - b. Grounding arrangements and connections for separately derived systems.
 - 2. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.

- a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- b. Include recommended testing intervals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. Harger Lightning & Grounding.
 - 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 5. SIEMENS Industry, Inc.; Energy Management Division.
 - 6. Thomas & Betts Corporation; A Member of the ABB Group.
 - 7. Approved equal.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kc mil, 14 strands of No. 17 AWG conductor, 1/4-inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8-inches wide and 1/16-inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4-inches in cross section, with 9/32-inch holes spaced 1-1/8-inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- H. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- I. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- J. Straps: Solid copper, copper lugs. Rated for 600 A.
- K. Water Pipe Clamps:
 1. Mechanical type, two pieces with stainless-steel bolts.

- a. Material: Copper
- b. Listed for direct burial.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor.
 - 1. Bury at least 24-inches below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2-inches minimum from wall, 6-inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except as otherwise indicated.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.

2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- C. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

C. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8-inches o.c. in at least one surface.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.
 - c. ERICO International Corporation.
 - d. Thomas & Betts Corporation; A Member of the ABB Group.
 - e. Approved equal.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Approved equal.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-line, an Eaton business.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) MKT Fastening, LLC.
 - 4) Approved equal.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA 101
 3. NECA 102.
 4. NECA 105.
 5. NECA 111.
- B. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be ¼-inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4-inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4-inches thick.
 - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.2 SUMMARY:

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

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. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Anamet Electrical, Inc.
 - d. Opti-Com Manufacturing Network, Inc (OMNI).
 - e. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - f. Approved equal.
2. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. GRC: Comply with ANSI C80.1 and UL 6.
4. ARC: Comply with ANSI C80.5 and UL 6A.
5. IMC: Comply with ANSI C80.6 and UL 1242.
6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040-inch, minimum.
7. EMT: Comply with ANSI C80.3 and UL 797.
8. FMC: Comply with UL 1; zinc-coated steel or aluminum.
9. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.

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. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Anamet Electrical, Inc.
 - d. FSR Inc.
 - e. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - f. Approved equal.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040-inch, with overlapping sleeves protecting threaded joints.

- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

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. AFC Cable Systems; a part of Atkore International.
 - b. Anamet Electrical, Inc.
 - c. FRE Composites.
 - d. RACO; Hubbell.
 - e. Thomas & Betts Corporation; A Member of the ABB Group.
 - f. Approved equal.

- B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 1. ENT: Comply with NEMA TC 13 and UL 1653.
 2. RNC: Type EPC-40-PVC or type EPC-80-PVC as noted complying with NEMA TC 2 and UL 651 unless otherwise indicated.
 3. LFNC: Comply with UL 1660.

- C. Nonmetallic Fittings:
 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. AFC Cable Systems; a part of Atkore International.
 - b. Anamet Electrical, Inc.
 - c. Arnco Corporation.
 - d. FRE Composites.
 - e. RACO; Hubbell.
 - f. Approved equal.

 2. Fittings, General: Listed and labeled for type of conduit, location, and use.

 3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

 4. Fittings for LFNC: Comply with UL 514B.

 5. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. B-line, an Eaton business.
 2. Hoffman; a brand of Pentair Equipment Protection.
 3. Mono Systems, Inc.
 4. Square D.

5. Approved equal.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Crouse-Hinds, an Eaton business.
 2. Erickson Electrical Equipment Company.
 3. Hoffman; a brand of Pentair Equipment Protection.
 4. Hubbell Incorporated.
 5. Approved equal.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
 1. Material: Cast metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
 - 1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Device Box Dimensions: as required for the use.
- M. Gang-able boxes are prohibited.
- N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- O. Cabinets:
 - 1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armorcast Products Company.
 - b. NewBasis.
 - c. Oldcastle Enclosure Solutions.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power Systems, Inc.
 - f. Approved equal.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC." or per appropriate system.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of hot-dip galvanized-steel diamond plate.

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. Armorcast Products Company.
 - b. NewBasis.
 - c. Nordic Fiberglass, Inc.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power Systems, Inc.
 - f. Approved equal.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC." or per appropriate system.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: GRC.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased as indicated on plans.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.

- B. Indoors: Apply raceway products as specified below unless otherwise indicated. All raceways shall be installed concealed within Gypsome walls and CMU.
 - 1. Exposed, Not Subject to Physical Damage: GRC.
 - 2. Exposed, Not Subject to Severe Physical Damage: GRC.
 - 3. Exposed and Subject to Severe Physical Damage: GRC.

 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: GRC.
 - 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X in damp or wet locations.

- C. Minimum Raceway Size: 3/4-inch trade size.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

- F. Install surface raceways only where indicated on Drawings.

- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6-inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12-inches of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12-inches of enclosures to which attached.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2-inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to GRC before rising above floor.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12-inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
- P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- R. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041-inch per foot of length of straight run per degree F of temperature change for PVC conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72-inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- W. Locate boxes so that cover or plate will not span different building finishes.
- X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6-inches in nominal diameter.
2. Install backfill as specified in Section 31 20 00 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12-inches of finished grade, make final

conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 00 00 "EARTHWORK."

4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3-inches of concrete for a minimum of 12-inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60-inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1-inch above finished grade.
- D. Install handholes with bottom below frost line.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements of manufacturer.

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.2 ACTION SUBMITTALS

- ###### A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.

- ###### B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50-inches and with no side larger than 16-inches, thickness shall be 0.052-inch.

- b. For sleeve cross-section rectangle perimeter 50-inches or more and one or more sides larger than 16-inches, thickness shall be 0.138-inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Company (The).
 - c. Pipeline Seal and Insulator, Inc.
 - d. Approved equal.
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, water-stop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber water-stop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. HOLDRITE.

2.4 GROUT

- A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2-inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position water stop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with ANSI Z535.4 for safety signs and labels.

- D. Comply with NFPA 70E requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- B. Color-Coding for Phase-Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit] conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 5. Color for Neutral: White or gray.
 - 6. Color for Equipment Grounds: Green.
- C. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36-INCHES."

E. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

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. Brady Corporation.
 - b. Brother International Corporation.
 - c. Ideal Industries, Inc.
 - d. Panduit Corp.
 - e. Approved equal.
2. Minimum Nominal Size:
 - a. 1-1/2 by 6-inches for raceway and conductors.
 - b. 3-1/2 by 5-inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

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. Champion America.
 - b. Ideal Industries, Inc.
 - c. Panduit Corp.
 - d. Approved equal.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2-inches wide; compounded for outdoor use.

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. Brady Corporation.
 - b. Emedco.
 - c. Marking Services, Inc.
 - d. Approved equal.

C. Underground-Line Warning Tape:

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. Brady Corporation.
 - b. Ideal Industries, Inc.
 - c. Marking Services, Inc.
 - d. Approved equal.
2. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

2.5 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

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. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Emedco.
 - d. Approved equal.
2. Engraved legend.
3. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16-inch thick.
 - b. For signs larger than 20 sq. in., 1/8-inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Hellermann Tyton.
 2. Ideal Industries, Inc.
 3. Marking Services, Inc.
 4. Panduit Corp.
 5. Approved equal.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 1. Minimum Width: 3/16-inch.
 2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior) in conformance with section 09 90 00.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Verify identity of each item before installing identification products.
- C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- D. Apply identification devices to surfaces that require finish after completing finish work.
- E. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- F. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- H. Standby power Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- J. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6-inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- K. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

- L. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8-inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.

- M. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2-inches high.

- N. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage.

- B. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

- C. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive equipment labels.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Controls with external control power connections.

- E. Arc Flash Warning Labeling: Self-adhesive labels.

- F. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

G. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION

SECTION 26 05 73

PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. This Section includes computer-based, fault-current, overcurrent protective device and protective relay coordination studies. Protective devices shall be set based on results of the study.
- B. Provide a full arc flash analysis per IEEE 1584 and include recommendations, printed warning labels, and submit calculations based upon project specific conditions and all equipment. In addition to IEEE 1584 Standard, evaluate and label all panels, transformers and equipment fed from transformers at or below 125 kVA.
- C. This study shall include all settings including equipment configuration settings, settings and configuration of all relays, fuses and switchgear. This study shall also require the provider to gather and confirm all applicable existing equipment nameplate information and device settings and review shop drawings for applicable information.
- D. This study shall include protective devices upstream of this project feeding the transformer to this building. All operating sequences and scenarios shall be included for both normal and generator sources. Study provider shall contact this utility company to find actual impedance and available fault current.
- E. The first study submission shall be included with the electrical equipment submittal incorporating actual specific project conditions. The first report shall confirm proper withstand rating of all equipment and selectivity for emergency through instantaneous region. The report shall then be revised and resubmitted per comments and reflect final approved equipment and recommended settings for each device.
- F. Final report shall be signed and sealed by a licensed engineer in the state of the project.

1.3 ACTION SUBMITTALS:

- A. Product Data: For computer software program to be used for studies.

- B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital and hard copy form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.
 - 4. Relay settings and configuration tables and calculations for actual submitted relays from shop drawings.
 - 5. Arc fault labels and stickers.

1.4 INFORMATIONAL SUBMITTALS:

- A. Protective Relays: Provide calculation backup for protective relays and configuration settings.
- B. Qualification Data: For coordination-study specialist.
- C. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE:

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS:

- A. Basis-of-Design Product: Subject to compliance with requirements, provide SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS:

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine Project protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.
 - 1. Coordination study to be submitted with and incorporate pre-approved, relevant equipment submittals. Protective devices specific to this project must be used in this study prior to their approval. Provide multiple submissions to have a complete report coordinated with, and submitted to, final approval electrical equipment shop drawings.
 - 2. Provide analysis for each and every relay for each and every sequence of operation scenario.
 - 3. Also provide recommendations for frequency, power, voltage and time settings including calculations. Provide interconnect relay settings coordinated with utility company where any onsite power is generated.

3.2 POWER SYSTEM DATA:

- A. Gather (gather means to actively garner required information through direct contact with utility company, owner, contractor, suppliers, etc., and include actual site investigation and confirm and find information) and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance, available fault, and required settings of utility service.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

- a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 - h. Each malfunction and digital and standalone relay including settings and relay configurations.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
- a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.
 - k. Each relay parameter, including but not limited to voltage, frequency, current and power.

3.3 FAULT-CURRENT STUDY:

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following below. Coordinate with utility company distribution engineer to obtain available fault level on the primary side of transformer/feeders serving the building.

1. Switchgear and switchboard bus (low-voltage and medium-voltage).
 2. Medium-voltage controller.
 3. Motor-control center.
 4. Distribution panelboard.
 5. Branch circuit panelboard.
 6. Low-voltage transformer.
 7. Automatic transfer switch.
 8. Generator.
 9. UPS and AC inverter.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242 and medium-voltage IEEE standards.
1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 3. Low-Voltage Fuses: IEEE C37.46.
 4. Circuit Breakers: IEEE C37.13.
- E. Study Report:
1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
- F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit

withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399. The study shall be performed using the actual available 3-phase bolted short-circuit current on the secondary of the utility transformer. This value will be obtained by the contractor from the utility company.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.
- C. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- D. Include all relays and all functions for each relay in the study including relay software, settings and configurations.
- E. Coordinate with contractor and manufacturers exact CT and PT ratios, polarity and configurations.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility

company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

- a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
3. Include tables and calculations for all relay functions including relay software settings and configurations.
- G. Completed data sheets for setting of protective and control devices.

3.5 ARC FLASH STUDY:

- A. Provide a complete arc flash study per IEEE 1584 Standards, including all printed labels and calculations.
- B. Provide time for follow-up and submission of revised settings per comments and final shop drawing coordination.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.2 SUMMARY

A. Section Includes:

1. Photoelectric switches.
2. Indoor occupancy and vacancy sensors.
3. Switchbox-mounted occupancy and vacancy sensors

B. Related Requirements:

1. Section 26 27 26 "WIRING DEVICES" for non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:
 - a. Occupancy sensors.
2. Interconnection diagrams showing field-installed wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty information.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

- B. Software and firmware operational documentation.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Industries, Inc.
 - 2. Intermatic, Inc.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Approved equal.
- B. Description: Solid state, with SPST dry contacts rated for the intended load. Complying with UL 773A, and compatible with ballasts and LED lamps.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 - 3. Time Delay: Fifteen-second minimum, to prevent false operation.
 - 4. Surge Protection: Metal-oxide varistor.
 - 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
 - 6. Failure Mode: Luminaire stays ON.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Hubbell Building Automation, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lutron Electronics Co., Inc.
4. Sensor Switch, Inc.
5. WattStopper; a Legrand® Group brand.
6. Approved equal.

B. General Requirements for Sensors:

1. Wall or Ceiling-mounted, as indicated solid-state indoor occupancy sensors.
2. Dual technology.
3. Integrated power pack.
4. Hardwired connection to switch.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - b. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A load at 120- and 277-V ac.
10. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

- C. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Separate for each sensing technology.
 - 2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12-inches in either a horizontal or a vertical manner at an approximate speed of 12-inches/s.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 - 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Bryant Electric.
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Lutron Electronics Co., Inc.
 - 4. Sensor Switch, Inc.
 - 5. WattStopper; a Legrand® Group brand.
 - 6. Approved equal.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, using hardwired connection.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 - 4. Switch Rating: rated for the intended load but not less than 800-VA.
- C. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. or 2100 sq. ft as required.
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: White.
11. Faceplate: Color matched to switch.

D. Wall-Switch Sensor:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft or 2100 sq. ft as required.
2. Sensing Technology: PIR.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: White.
11. Faceplate: Color matched to switch.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 26 05 19 "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES." Minimum conduit size is 3/4-inch unless noted otherwise.
- B. Wiring within Enclosures: Separate power-limited and non-power limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Operational Test: After installing switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 26 22 13

LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.0 SUMMARY

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for transformers, accessories, and components, from manufacturer.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Eaton.
 2. General Electric Company.
 3. Jefferson Electric, Inc.
 4. Siemens Industry, Inc., Energy Management Division.
 5. Sola/Hevi-Duty; a brand of Emerson Electric Co.
 6. Square D; by Schneider Electric.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the transformer will remain in place without separation of any parts when subjected to the seismic forces specified and the transformer will be fully operational after the seismic event."

2.3 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.
 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:
 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

- E. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
- F. Coils: Continuous windings without splices except for taps.
 - 1. Coil Material: Copper.
 - 2. Internal Coil Connections: Brazed or pressure type.
 - 3. Terminal Connections: Welded.
- G. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.4 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."
- B. Nameplates: Self-adhesive label for each distribution transformer. Self-adhesive labels are specified in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 03 30 00 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."
 - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections.
- D. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
 - 1. Visual and Mechanical Inspection.
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, and grounding.
 - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
 - d. Verify the unit is clean.
 - e. Perform specific inspections and mechanical tests recommended by manufacturer.
 - f. Verify that as-left tap connections are as specified.
 - g. Verify the presence of surge arresters and that their ratings are as specified.
 - 2. Electrical Tests:
 - a. Measure resistance at each winding, tap, and bolted connection.
 - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
 - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
 - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- E. Remove and replace units that do not pass tests or inspections and retest as specified above.
- F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for SPD as installed in panelboard.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 FIELD CONDITIONS

- A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface -mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Height: 84-inches maximum.

3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- F. Incoming Mains Location: Top or Bottom.
- G. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
- I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices including feed thru lugs.
- J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
 2. General Electric Company; GE Energy Management - Electrical Distribution.
 3. Square D; by Schneider Electric.
 4. Approved equal.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36-inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers or Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Eaton.
 2. General Electric Company; GE Energy Management - Electrical Distribution.
 3. SIEMENS Industry, Inc.; Energy Management Division.
 4. Square D; by Schneider Electric.
 5. Approved equal.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
 - 5. Approved equal.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NECA 407.
- C. Mount top of trim 90-inches above finished floor unless otherwise indicated.

- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- H. Install filler plates in unused spaces.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
- E. Install warning signs complying with requirements in Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Straight-blade convenience receptacles.
2. GFCI receptacles.
3. Toggle switches.
4. Wall switch sensor light switches with dual technology sensors.
5. Wall plates.

1.2 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.
- D. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.
- E. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations

2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. 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. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - e. Approved equal.

2.3 GFCI RECEPTACLES

- A. General Description:
 - 1. 125 V, 20 A, straight blade, feed-through type.

2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles:

1. 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. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - e. Approved equal.

2.4 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Eaton (Arrow Hart).
 - 2) Hubbell Incorporated; Wiring Device-Kellems.
 - 3) Leviton Manufacturing Co., Inc.
 - 4) Pass & Seymour/Legrand (Pass & Seymour).
 - 5) Approved equal.
2. Two Pole:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Eaton (Arrow Hart).
 - 2) Hubbell Incorporated; Wiring Device-Kellems.
 - 3) Leviton Manufacturing Co., Inc.
 - 4) Pass & Seymour/Legrand (Pass & Seymour).
 - 5) Approved equal.

3. Three Way:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Eaton (Arrow Hart).
 - 2) Hubbell Incorporated; Wiring Device-Kellems.
 - 3) Leviton Manufacturing Co., Inc.
 - 4) Pass & Seymour/Legrand (Pass & Seymour).
 - 5) Approved equal.

4. Four Way:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Eaton (Arrow Hart).
 - 2) Hubbell Incorporated; Wiring Device-Kellems.
 - 3) Leviton Manufacturing Co., Inc.
 - 4) Pass & Seymour/Legrand (Pass & Seymour).
 - 5) Approved equal.

C. Pilot-Light Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - e. Approved equal.
2. Description: Single pole, with LED-lighted handle, illuminated when switch is off.

2.5 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: High-impact thermoplastic in finished spaces.

3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.6 FINISHES

- A. Device Color:
1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pig tailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6-inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

H. GFCI Receptacles: Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.2 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 - 1. Tests for Convenience Receptacles:
 - a. Line Voltage: Acceptable range is 105 to 132 V.
 - b. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - c. Using the test plug, verify that the device and its outlet box are securely mounted.
 - d. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Panelboards.
 - c. Enclosed controllers.
 - d. Enclosed switches.

1.2 ACTION SUBMITTALS

- ###### A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

- ###### A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- ###### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.
4. Mersen USA.
5. Approved equal.

2.2 CARTRIDGE FUSES

- ###### A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC.
 2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC.
 3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC.
 4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC.
 5. Type J: 600-V, zero- to 600-A rating, 200 kAIC.
 6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC.
 7. Type T: 600-V, zero- to 800-A rating, 200 kAIC.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.2 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Non-fusible switches.
 - 3. Enclosures.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
 - 5. Approved equal.

- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
 - 4. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.

- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.4 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
 - 5. Approved equal.

- B. Type HD, Heavy Duty, Three Pole, Single Throw: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).
- C. Operating Mechanism: The circuit-breaker operating handle shall be externally operable directly operable through the front cover of the enclosure (NEMA 250 Type 1)

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

3.2 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.
- F. Set field-adjustable circuit-breaker trip ranges to values indicated on the Drawings.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections: All testing is to be done by the contractor with the assistance of the manufacturer as required.
- B. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate

from those of similar bolted connections by more than 50 percent of the lowest value.

- 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Measure contact resistance across each switchblade fuse holder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.
 - f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - h. Perform adjustments for final protective device settings in accordance with the coordination study.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
- 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

SECTION 26 29 13

MANUAL AND MAGNETIC MOTOR CONTROLLERS

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 the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. CCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.
- C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- D. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 92 13 "OPERATION AND MAINTENANCE DATA," include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.8 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Indicating Lights: Two of each type and color installed.
 4. Auxiliary Contacts: Furnish one spare for each size and type of magnetic controller installed.
 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.9 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. PROJECT CONDITIONS

C. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.11 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - f. Approved equal.
 2. Configuration: Non-reversing.
 3. Surface mounting.
 4. Red pilot light.

- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - f. Approved equal.
 2. Configuration: Non-reversing.
 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 4. Surface mounting.
 5. Red pilot light.
- D. Magnetic Controllers: Full voltage, across the line, electrically held.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - f. Approved equal.
 2. Configuration: Non-reversing.
 3. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 5. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.
 6. Solid-State Overload Relay:

- a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- E. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - f. Approved equal.
 - 2. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
- 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Wash-Down Areas: Type 4X, stainless steel.
 - 4. Other Wet or Damp Indoor Locations: Type 4X.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
- 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.
 - a. Push Buttons: Recessed types; momentary as indicated.

- b. Pilot Lights: LED types; colors as indicated.
 - c. Selector Switches: Rotary type.
- 2. Elapsed Time Meters: Heavy duty with digital readout in hours; resettable.
- B. Two sets of reversible N.C./N.O. auxiliary contact(s).
- C. All starters shall include Hand-Off-Auto with a low voltage digital input to command it on/off
- D. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- E. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- G. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. The contractor who furnishes equipment requiring a motor controller shall provide motor controllers for all motors with all specified options and accessories.
- B. Select features of each enclosed control to coordinate with ratings and characteristics of supply circuit and motor.
- C. Select horsepower rating of controllers to suit motor controlled.
- D. Provide each enclosed controller with an H.O.A. switch, pilot lights, pushbuttons, elapsed time meter, integral transformer and fusing.

- E. Location: Locate enclosed controller within sight of motor controller in readily accessible location, unless otherwise required. When controller is not located within sight of the motor, provide an additional maintenance enclosed switch at the motor.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect, Construction Manager and Owner before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION

SECTION 26 32 13

PACKAGED DIESEL ENGINE GENERATOR 60KW

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. This Section includes packaged gas-engine generator sets with the following features and accessories:
 - 1. Battery charger.
 - 2. Engine-generator set.
 - 3. Muffler.
 - 4. Exhaust piping external to set.
 - 5. Radiator.
 - 6. Remote stop switch.
 - 7. Starting battery.
- B. Related Sections include the following:
 - 1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.03 DEFINITIONS:

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

1.04 SUBMITTALS:

- A. Product Data: Include the following:

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1. Data on features, components, accessories ratings, and performance.
 2. Thermal damage curve for generator.
 3. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 4. Wiring Diagrams: Power, signal, and control wiring.
- C. Welding certificates.
- D. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Qualification Data: For Installer and manufacturer.
- F. Certified summary of prototype-unit test report.
- G. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
- H. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet performance criteria for sensitive loads.

- I. Test Reports:
 - 1. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - 2. Report of sound generation.
 - 3. Report of exhaust emissions showing compliance with applicable regulations.
 - 4. Field quality-control test reports.
- J. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.
- K. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Manuals," include the following:
 - 1. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- L. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE:

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 - 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged generator sets and are based on the specific system indicated.
- F. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX for welding exhaust system piping.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- H. Comply with NFPA 37.
- I. Comply with NFPA 70.
- J. Comply with NFPA 99.
- K. Comply with NFPA 110 requirements for Level 2 emergency power supply system.
- L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.06 COORDINATION:

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.07 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: Five years from date of Substantial Completion.

1.08 MAINTENANCE SERVICE:

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization.

Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts and supplies as used in manufacture and installation of original equipment.

1.09 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: One for every 10 of each type and rating, but not less than one of each.
 - 2. Indicator Lamps: Two for every six of each type used, but not less than two of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Caterpillar; Engine Div.
 - 2. Kohler Co; Generator Division.
 - 3. Approved equal

2.02 ENGINE-GENERATOR SET:

- A. Packaged engine-generator set shall be a coordinated assembly of compatible components.
- B. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
- C. Output Connections: Three phase, Four wire.
- D. Safety Standard: Comply with ASME B15.1.
- E. Nameplates: Each major system component shall be equipped with a nameplate to identify manufacturer's name and address, and model and serial number of component.

- F. Fabricate engine-generator-set mounting frame and attachment of components to resist generator-set movement during a seismic event when generator-set mounting frame is anchored to building structure.
- G. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

2.03 GENERATOR-SET PERFORMANCE:

- A. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.
- B. Steady-State Voltage Modulation Frequency: Less than 1 Hz.
- C. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
- D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- E. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
- F. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
- G. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
- H. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
- I. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.04 SERVICE CONDITIONS:

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: -5 to 104 deg F.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

B. Unusual Service Conditions: Engine-generator equipment and installation are required to operate under the following conditions:

None .

2.05 ENGINE:

A. Rated Engine Speed: 1800 rpm.

B. Fuel: Diesel.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Diesel fuel system shall include the following items.
 - a. Fuel injection system
 - b. Fuel line solenoid valve
 - c. Flexible fuel connections
 - d. Fuel filters
 - e. Base mounted fuel tank with rupture basin and leak detection.

- f. Any other components normally supplied or recommended by the engine manufacturer for this application. The unit shall run on No. 2 domestic heating oil. An engine requiring premium fuels will not be accepted.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 2 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.

2.06 ENGINE COOLING SYSTEM:

- A. Horizontal air discharge. Unit is rated for specified coolant.
 - 1. Radiator Core Tubes: Nonferrous-metal construction other than aluminum.
 - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 3. Fan: Driven by multiple belts from engine shaft or totally enclosed electric motor with sealed bearings.
- B. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
- C. Radiator: Rated for specified coolant.
- D. Description: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
- E. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
- F. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- G. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - 1. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - 2. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- H. Coolant piping external to engine-generator set. Use ASTM B 88, Type L (ASTM B 88M, Type B) copper tubing with brazed joints, sized as recommended by engine manufacturer. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation and joint construction.

2.07 ENGINE EXHAUST SYSTEM:

- A. Muffler: Critical type, sized as recommended by engine manufacturer; sound level measured at a distance of 10 feet (3 m) from exhaust discharge shall be 85 dBA or less.
- B. Condensate Drain for Muffler: Schedule 40, black steel pipe connected to muffler drain outlet through a petcock.
- C. Connection from Engine to Exhaust System: Flexible section of corrugated stainless-steel pipe.
- D. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liner.
- E. Exhaust Piping External to Engine: ASTM A 53/A 53M, Schedule 40, welded, black steel, with welded joints and fittings.

2.08 COMBUSTION-AIR INTAKE:

- A. Description: Heavy-duty, engine-mounted air cleaner with replaceable dry filter element and "blocked filter" indicator.

2.09 STARTING SYSTEM:

- A. Description: electric, with negative ground and including the following items:
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article.
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: 60 seconds.
 - 4. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article to provide specified cranking cycle at least three times without recharging.
 - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 - 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article. Include accessories required to support and fasten batteries in place.
 - 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.10 CONTROL AND MONITORING:

- A. Functional Description: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of the generator set. When mode-selector switch is switched to the on position, the generator set starts. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.
- B. Functional Description: Switching on-off switch on the generator control panel to the on position starts the generator set. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

- D. Indicating and protective devices and controls shall include those required by NFPA 110 for a Level 2 system, and the following:
- E. Indicating and Protective Devices and Controls:
1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Start-stop switch.
 11. Overspeed shutdown device.
 12. Coolant high-temperature shutdown device.
 13. Coolant low-level shutdown device.
 14. Oil low-pressure shutdown device.
 15. Generator overload.
- F. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- G. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 16 Section "Electrical Power Monitoring and Control."
- H. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 2 systems. Include necessary contacts and terminals in control and monitoring panel.
- I. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
1. Engine high-temperature shutdown.
 2. Lube-oil low-pressure shutdown.
 3. Overspeed shutdown.
 4. Remote emergency-stop shutdown.
 5. Engine high temperature prealarm.
 6. Lube-oil low-pressure prealarm.
 7. Low coolant level.
 8. Overcrank shutdown.
 9. Coolant low-temperature alarm.
 10. Control switch not in auto position.

11. Battery-charger malfunction alarm.
12. Battery low-voltage alarm.

- J. Remote Alarm Annunciator: Comply with NFPA 99. Labeled LED shall identify each alarm event. Common audible signal shall sound for alarm conditions. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- K. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.11 GENERATOR OVERCURRENT AND FAULT PROTECTION:

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
 2. Trip Rating: Matched to generator rating.
 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Protector: Microprocessor-based unit that continuously monitors current level in each phase of generator output, integrates generator heating effect over time, and predicts when thermal damage of the alternator will occur. When signaled by the protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from the load circuits. Protector shall perform the following functions:
1. Initiates a generator overload alarm when the generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single or three-phase fault conditions, regulates the generator to 300 percent of rated full-load current for up to 10 seconds.
 3. As the overcurrent heating effect on the generator approaches the thermal damage point of the unit, the protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- C. Ground-Fault Indication: Comply with NFPA 70, Article 700-7(d). Integrate ground-fault alarm indication with other generator-set alarm indications.

2.12 GENERATOR, EXCITER, AND VOLTAGE REGULATOR:

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- A. Comply with NEMA MG 1 and specified performance requirements.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Excitation shall use no slip or collector rings, or brushes, and shall be arranged to sustain generator output under short-circuit conditions as specified.
- G. Enclosure: Drip proof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Sub transient Reactance: 12 percent, maximum.

2.13 FINISHES:

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.14 SOURCE QUALITY CONTROL:

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 energy converters in Paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2.

2. Generator Tests: Comply with IEEE 115.
3. Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype shall have been factory tested to demonstrate compatibility and reliability.

2.15 WEATHER PROTECTIVE ENCLOSURE:

A weather protective enclosure housing shall be supplied and shall enclose the complete unit and all related equipment. All components shall be wired and piped within the enclosure. The housing shall be constructed of aluminum with stainless steel hardware and shall include hinged locking access doors, weather protective fixed louvers, and weather protective flanged door openings to insure weather-resistant construction. Housing shall be painted in accordance with manufacturer's recommendations, and the color shall be as required by the Owner or the Engineer, Section 09 90 00 PAINTING, and coordinated with all site equipment.

1. The weather protective housing shall be sound insulated, vandal proof, pad locked, baffled housing to enclose the entire engine generator and auxiliary equipment. The sound proof insulation shall consist of closed cell vinyl foam covering on all the inside walls of the enclosure. In addition both intake and exhaust louvers of the enclosure shall have baffles. The resulting structure with generator in operation shall not transmit more than 75 db (A-weighted) at a distance of 25 feet from the generator in any direction. It shall be the responsibility of the generator set manufacturer to choose thickness of insulation, number of baffles, etc. to meet the aforementioned sound criteria. In addition, silencers shall be installed as part of the exhaust system, mounted within the enclosure to obtain 75 db (A-weighted) or less at a distance of 25 feet.
2. 2-24 VDC lighting fixtures controlled by a 15 minute timer shall be included in the generator housing wired to the 24 volt battery.
3. In addition, a 120 volt, duplex receptacle shall be supplied flush mounted in the side of the power and control junction box.
4. Access door shall be provided to allow maintenance access to the generator. These shall be constructed of 14 GA (0.063-in.) aluminum. Lockable handles and three-point cadmium plated latches will be installed at each door. Panels will be constructed to prevent water intrusion and have complete weather stripping.
5. Ventilation will be provided by a fixed vane air intake louver of sufficient size to allow for cooling and combustion air as specified by the generator manufacturer. Air exhaust shall be by a gravity louver. The design of the air intake louver shall maintain air velocities below 1,000 feet per minute and restrict water carry over to 0.1 ounces of water per square foot of free area in 15 minutes in accordance with AMCA Standard 500. The enclosure shall incorporate internal sound absorption at the air intake and exhaust ends of the enclosure to reduce noise transmission in all directions from the enclosure to the level required by local codes or regulations. Sound attenuating

system shall not restrict the amount of airflow required by the generator set manufacturer. Wire mesh shall be provided on the inside to prevent entry by birds or rodents.

6. Silencer clamps, brackets and rain collar shall be provided and sized as recommended by the muffler manufacturer.
7. All skin penetrations and joints shall be sealed with a silicone based sealant. All exterior fasteners shall be self-gasketing.
8. Solid aluminum rub rails shall be provided at top and bottom of all walls. Enclosure lift rings shall be provided to allow removal of the enclosure from the base. The enclosure shall be mounted to the base fuel tank. The roof shall be cambered to shed water.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CONCRETE BASES:

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Basic Electrical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.

3.03 INSTALLATION:

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generators level on concrete base.

1. Vibration Isolation: Mount packaged engine generators on rubber pads or restrained spring isolators. Vibration isolation devices and installation requirements shall be per the manufacturers recommendations.
- C. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- D. Install cooling-system piping, accessories, hangers and supports, and anchors for complete installation.
1. Hanger, support, and anchor devices are specified in Division 22 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
 2. Install the following pipe attachments:
 - a. Adjustable steel clevis hangers for individual horizontal piping less than 20-feet long.
 - b. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - c. Spring hangers to support vertical runs.
 3. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - a. NPS 1 and Smaller: Maximum span, 7-feet; minimum rod size, 1/4-inch.
 - b. NPS 1-1/2: Maximum span, 9-feet; minimum rod size, 3/8-inch.
 - c. NPS 2 and Larger: Maximum span, 10 feet; minimum rod size, 3/8-inch.
 4. Support cooling-system piping with pipe hangers spaced horizontally and at each floor vertically. Pipe hangers are specified in Division 22 Section "Hangers and Supports."
 5. Restrain cooling-system piping with cable-type bracing assemblies
 6. Extend drain piping from heat exchangers to point of disposition.
- E. Install exhaust-system piping. Extend to point of termination outside structure. Size piping according to manufacturer's written instructions.
1. Install condensate drain piping for engine exhaust system. Extend drain piping from low points of exhaust system and from muffler to condensate traps and to point of disposition.
 2. Restrain exhaust piping and mufflers with cable-type bracing assemblies
- F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.04 CONNECTIONS:

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- A. Piping installation requirements are specified in Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 - 1. Install fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
 - 2. Connect cooling-system water supply and drain piping to gas-engine heat exchangers. Install flexible connectors at connections to engine generator and remote radiator.
 - 3. Connect fuel piping to engines with a gate valve and union.
 - 4. Connect exhaust-system piping to engines.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."
- C. Connect wiring according to Division 26 Section "Conductors and Cables."
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 IDENTIFICATION:

- A. Identify system components according Division 26 Section "Electrical Identification."

3.06 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.15.2.1 and 7.22.1 (except for vibration baseline test). Certify compliance with test parameters.
 - 2. Perform tests recommended by manufacturer.
 - 3. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, the following:
 - a. Single-step full-load pickup test.
 - 4. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

- a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
5. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 6. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 7. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 8. Exhaust Emissions Test: Comply with applicable government test criteria.
 9. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases, decreases, and verify that performance is as specified.
 10. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 11. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
 - D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of the National Institute for Standards and Technology, and adequate for making positive observation of test results. Make calibration records available for examination on request.
 - E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - H. Remove and replace malfunctioning units and reinspect as specified above.
 - I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.07 STARTUP SERVICE:

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
- C. Complete installation and startup checks according to manufacturer's written instructions.

3.08 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Project Closeout."
 - 1. Coordinate this training with that for transfer switches.

END OF SECTION

SECTION 26 36 00
TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes automatic transfer switches rated 600 V and less.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 - 2. Single-Line Diagram: Show connections between transfer switch, power sources, and load.

1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For transfer switches, accessories, and components, from manufacturer.
- B. Source quality control reports.
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- K. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- L. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- M. Battery Charger: For generator starting batteries.
 - 1. Float type rated 10 A.

2. Ammeter to display charging current.
 3. Fused ac inputs and dc outputs.
- N. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed tape or shrinkable sleeve markers at terminations. Color-coding and wire and cable markers are specified in Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 4. Accessible via front access.
- O. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 MOLDED-CASE-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Caterpillar, Inc.; Electric Power Division.
 2. Kohler Power Systems.
 3. Approved equal
- B. Comply with Level 2 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using contactor-based components are acceptable.
 2. Switch Action: Double throw; mechanically held in both directions.
 3. Contacts: Silver composition or silver alloy for load-current switching.
 4. Conductor Connectors: Suitable for use with conductor material and sizes.
 5. Material: Hard-drawn copper, 98 percent conductivity.
 6. Main and Neutral Lugs: Mechanical type.
 7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 8. Ground bar.
 9. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- F. Transfer Switches Based on Molded-Case-Switch Components: Comply with UL 489 and UL 869A.
- G. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
 2. Under-voltage Sensing for Each Phase of Normal and Alternative Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained under-voltage of standby source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and standby-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Standby Power Supervision: Red light with nameplate engraved "Standby Source Available."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to standby power source regardless of condition of normal source. Pilot light indicates override status.
 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
 1. For each of the tests required by UL 1008, performed on representative devices, for standby systems. Include results of test for the following conditions:
 - a. Overvoltage.
 - b. Under-voltage.
 - c. Loss of supply voltage.
 - d. Reduction of supply voltage.
 - e. Alternative supply voltage or frequency is at minimum acceptable values.
 - f. Temperature rise.
 - g. Dielectric voltage-withstand; before and after short-circuit test.
 - h. Overload.
 - i. Contact opening.
 - j. Endurance.
 - k. Short circuit.
 - l. Short-time current capability.
 - m. Receptacle withstand capability.
 - n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Floor-Mounting Switch (if furnished): Anchor to floor by bolting.
 - 1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
 - 2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
 - 3. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 26 05 26 "GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS."
- E. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.
- F. Final connections to equipment shall be made with liquid-tight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual and Mechanical Inspection:

- a. Compare equipment nameplate data with Drawings and Specifications.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and required clearances.
- d. Verify that the unit is clean.
- e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
- f. Verify that manual transfer warnings are attached and visible.
- g. Verify tightness of all control connections.
- h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
- i. Perform manual transfer operation.
- j. Verify positive mechanical interlocking between normal and alternate sources.
- k. Perform visual and mechanical inspection of surge arresters.
- l. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
 - 3) Verify correct functioning of draw-out disconnecting contacts, grounding contacts, and interlocks.

2. Electrical Tests:

- a. Perform insulation-resistance tests on all control wiring with respect to ground.
- b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
- c. Verify settings and operation of control devices.
- d. Calibrate and set all relays and timers.
- e. Verify phase rotation, phasing, and synchronized operation.
- f. Perform automatic transfer tests.
- g. Verify correct operation and timing of the following functions:

- 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 4. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and retransfer from standby source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- B. Coordinate tests with tests of generator and run them concurrently.
 - C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

- D. Transfer switches will be considered defective if they do not pass tests and inspections.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

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 field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Requirements:
 - 1. Section 26 24 16 "PANELBOARDS" for factory-installed SPDs.

1.3 DEFINITIONS:

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS:

- A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS:

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY:

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS:

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE SUPPRESSOR:

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 1. ABB USA.
 2. Eaton Corporation.

3. Emerson Electric Co.
4. GE Zenith Controls.
5. PowerLogics, Inc.
6. Schneider Electric Industries SAS.
7. Siemens Industry, Inc.
8. Current Technology; Danaher Power Solutions.
9. Approved equal.

B. SPDs: Comply with UL 1449, Type 1.

1. SPDs with the following features and accessories:
 - a. Integral disconnect switch.
 - b. Comply with UL 1449.
 - c. Modular design (with field-replaceable modules).
 - d. Redundant suppression circuits.
 - e. Redundant replaceable modules.
 - f. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - g. Indicator light display for protection status.
 - h. Form-C contacts one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 - i. Surge counter.

C. Comply with UL 1283.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Line to Line: 2000 V for 480Y/277 V.

F. SCCR: Equal or exceed 200 kA.

G. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. ABB USA.
 2. Eaton Corporation.
 3. Emerson Electric Co.
 4. GE Zenith Controls.
 5. PowerLogics, Inc.
 6. Schneider Electric Industries SAS.
 7. Siemens Industry, Inc.
 8. Current Technology; Danaher Power Solutions.
 9. Approved equal.
- B. SPDs: Comply with UL 1449, Type 2.
1. Comply with UL 1449.
 2. Modular design (with field-replaceable modules).
 3. Include LED indicator lights for power and protection status.
 4. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 5. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Comply with UL 1283.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: 1200 V for 480Y/277 V
 2. Line to Ground: 1200 V for 480Y/277 V
 3. Neutral to Ground: 1200 V for 480Y/277 V
 4. Line to Line: 2000 V for 480Y/277 V
- F. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.
 2. Line to Ground: 700 V.
 3. Neutral to Ground: 700 V.
 4. Line to Line: 1200 V.
- G. SCCR: Equal or exceed 200 kA.
- H. Inominal Rating: 20 kA.

2.4 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.

2.5 CONDUCTORS AND CABLES:

- A. Power Wiring: Same size as SPD leads, complying with Section 26 05 19 "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."
- B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 26 05 19 "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 26 05 19 "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground. Utilize #6 AWG low-impedance cable (Current Technology HPI TVSS Connection System).
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
 - 1. Power Wiring: Comply with wiring methods in Section 26 05 19 "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."
 - 2. Controls: Comply with wiring methods in Section 26 05 19 "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."

3.2 FIELD QUALITY CONTROL:

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE:

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Section Includes:

1. Interior luminaires, lamps, drivers, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Luminaire supports.

B. Related Sections:

1. Section 26 09 23 "LIGHTING CONTROL DEVICES" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS:

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LED: Light emitting diode (lamp assembly).
- D. LER: Luminaire efficacy rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. SSL: Solid-state lighting.

1.4 ACTION SUBMITTALS:

- A. Product Data: For each type of luminaire, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of luminaire including dimensions.
 2. Emergency lighting units including battery and charger.
 3. Ballast, including BF.
 4. Energy-efficiency data.
 5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project.
 - a. Photometric data for all LED products shall be certified by an IESNA LM-79 test report.
 - b. Life expectancy data for all LED products shall be certified by an IESNA LM-80 test report.
 7. Plans: Plans containing computer-generated point-by-point layout in all spaces that interior luminaires submitted or substitutions are located.
 - a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS:

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches of the plane of the luminaires.

4. Ceiling-mounted projectors.
5. Structural members to which suspension systems for luminaires will be attached.
6. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Sprinklers.
 - c. Smoke and fire detectors.
 - d. Occupancy sensors.
 - e. Access panels.
7. Perimeter moldings.

- B. Qualification Data: For qualified agencies providing photometric data for luminaires.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS:

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Lamps: Furnish at least five of each type.
 2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 3. Fluorescent-fixture-mounted, emergency battery pack: Furnish at least two of each type.
 4. Globes and Guards: Furnish at least one of each type.

1.8 QUALITY ASSURANCE:

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated,

that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- E. International Fire Code Compliance: Comply with visibility and luminance requirements for exit signs.

1.9 COORDINATION:

- A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies. Coordinate type of luminaire with ceiling type and insulation. Notify Engineer of conflicts prior to ordering fixtures via coordination drawings described in this Section.

1.10 WARRANTY:

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: Three full years from date of Substantial Completion. a prorated warranty is not acceptable.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Products: Subject to compliance with requirements below.
 - 1. Luminaires:
 - a. If one manufacturer is listed in Luminaire Schedule followed by the words "or equal," contractor may submit on any manufacturer with similar characteristics to those listed under description.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS:

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. LED Luminaires: Comply with UL 1598. Test according to IESNA LM-79 and LM-80 as applicable.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- F. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum thickness unless otherwise indicated. D12 pattern.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
- G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. CCT and CRI for all luminaires.
- H. Mounting Provisions for Ceiling Trim: Mounting provisions and ceiling trim are not indicated on the specific luminaire type specification. Coordinate mounting provisions and ceiling trim in the field, prior to the ordering of luminaires to match all ceiling types and installation configurations. Provide all necessary mounting hardware, hangers, rails, yokes, steams, chains, cables, etc.

2.3 BALLASTS - GENERAL REQUIREMENTS:

- A. Description: Include the following features, unless otherwise indicated.

1. Voltage: Field verify all voltage requirements prior to releasing lighting package and provide ballast voltages as required by circuiting on Plans.
2. Disconnecting Means: Code-approved disconnecting means within each luminaire.

2.4 DRIVERS FOR LED LAMPS:

- A. Description: Electronic driver designed for applicable fixture(s) and load indicated by LED lamps. Driver shall be designed for full light output unless dimmer or bi-level control is indicated.
1. Input Voltage Range: 120-277, +/-10%.
 2. Output Current: 0.35A dc.
 3. Input Frequency: 50/60 Hz.
 4. Power Factor: >90% at full load.
 5. THD: <20% at full load.
 6. Case temperature rated for -40 deg C through +80 deg C.
 7. Overheat protection, self-limited short-circuit protection and overload protected.
 8. Primary fused.

2.5 EXIT SIGNS:

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction. Comply with International Fire Code for size of Chevron-type circuits and indicator, which must be identifiable as a directional indicator at a distance of 40ft.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its

normal power supply, providing visual confirmation of either proper or failed emergency response.

- g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.6 EMERGENCY LUMINAIRES:

- A. General Requirements for Emergency Luminaires: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.7 LED LAMPS:

- A. Manufacturers: Subject to compliance with requirements, provide one of the following products:

1. Cree.
2. Nichia.
3. Lumileds.
4. Approved equal.

- B. Provide tight binning to maintain Kelvin temperature between +/-100 K. Indoor lighting to be 3500 K unless noted otherwise.

2.8 LED LUMINAIRES:

- A. Provide luminaires complete with drivers compatible with control type.
- B. Provide LM 79 and LM 80 reports with luminaire submittal.
- C. Provide full IES photometric files with fixture submittal and run photometric calculations if fixture is other than base spec.

2.9 LUMINAIRE SUPPORT COMPONENTS:

- A. Comply with Section 26 05 29 "HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Luminaires:
 - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
 - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Lay-in Ceiling Luminaires Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from luminaire corners.
2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least two independent support rods or wires from structure to a tab on diagonal corners of luminaire. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
5. Pendant Stem-Mounted Fixtures: Connect luminaire body to building structure with aircraft cable run through the fixture stem.

E. Connect wiring according to Section 26 05 19 "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."

F. Luminaire Locations: Refer to architectural reflected ceiling plans, sections, elevations and details for exact luminaire locations, mounting heights, and mounting arrangements.

3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 05 53 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner.

3.5 ADJUSTING

- A. Luminaire Aiming: For adjustable luminaires, aim all luminaires per Engineer's directions.

END OF SECTION

SECTION 31 00 00
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY:

- A. Work Included: Furnish all labor, supervision, equipment, supplies, and materials and perform all operations necessary to complete the work of this Section, including but not limited to the following:
1. Earth excavation of all types.
 2. Filling to raise grades, compaction and grading.
 3. Sheet piling, shoring and dewatering of excavations and trenches.
 4. Excavation and backfill for removal, relocation, and abandonment of existing underground utilities, foundations, and below-grade structures.
 5. Preparing subgrades for structures, walls, pavers, and landscaping.
 6. Providing, processing, placing, and compacting earth and aggregate fill materials.
 7. Removal, hauling, stockpiling, re-handling, and placement of materials.
 8. Off-site disposal of excess or unsuitable materials.
 9. Preserving and protecting existing site features to remain, and new site improvements during the course of the work.

1.2 PROJECT CONDITIONS:

- A. Site-Specific Information:
1. Refer to Section 00 31 32 SUBSURFACE DATA for information on site and subsurface conditions.
 2. Groundwater should be expected to be encountered in site excavations. Dewatering will be required to maintain groundwater levels a minimum of 2 ft. below subgrades and to complete work in-the-dry. The need for temporary excavation support is expected where sloped excavations are not possible and where excavations are completed adjacent to existing structures.
 3. Silty soils are highly susceptible to softening and disturbance by construction activity during wet or freezing weather. Subgrade protection is the responsibility of the contractor and special precautions and protective measures appropriate for the weather conditions during construction shall be used during earthwork and foundation construction to preserve the integrity of subgrades. Disturbed subgrades shall be repaired at the sole expense of the Contractor.

C. Geotechnical Field and Laboratory Testing:

1. The Contractor shall retain the services of a geotechnical testing laboratory to conduct the laboratory analyses and field testing of soil materials required by this specification. Coordinate locations and types of field tests to be performed with the Owner's Engineer and cooperate in every way with the Owner's Engineer and testing laboratory during field testing and with collection of soil samples for laboratory testing.

D. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by the Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 General Requirements Specification Sections, apply to this Section.
2. Section 00 31 32 – SUBSURFACE DATA
3. Section 01 11 00 – CONTROL OF WORK AND MATERIALS
4. Section 01 57 19 – ENVIRONMENTAL PROTECTION
5. Section 31 23 19 – DEWATERING
6. Section 31 50 00 - SUPPORT OF EXCAVATION
7. Section 31 63 33 – DRILLED MICROPILES
8. Section 32 12 00 - PAVING
9. Section 32 91 19 – SEEDING

1.3 SUBMITTALS AND TESTING:

A. Material Test Reports: From a qualified independent testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 and moisture content according to ASTM D 2216 of each on-site and borrow soil and/or fill material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 1557 for each onsite and borrow soil and/or fill material proposed for fill and backfill.

B. Supply and Quality Control Inspection Results: Submit the results of all sources of supply and quality control inspections and tests. No work shall be performed until the Owner's Engineer has reviewed the source of supply. It is the Contractor's responsibility to submit the Supply and Quality Control Inspection Results in a timely manner to assure the project's workflow.

1. Backfill Materials:

- a. A certification statement and analytical results shall accompany each

physical sample of earth materials to be imported onto the site, including but not limited to crushed stone, loam, bedding sand, gravel sub-base, common borrow and structural fill. At a minimum the certification shall state the point of origin and that the material is free of contaminants. The certification shall include representative sample analysis from each point of origin of backfill to be used on the site. The sample(s) shall be analyzed by a certified laboratory for total metals (EPA priority pollutant metals), volatile organic compounds (EPA Method 8260), semi-volatile organic compounds (EPA Method 8270), petroleum hydrocarbons (EPA Method 8100), and Total PCBs and pesticides (EPA Method 8081 and 8082).

- b. All sampling of soils for chemical testing shall be performed by a person experienced in sample collection and shall be either: 1) a Professional Geologist registered in the State of New Hampshire; 2) a Professional Engineer registered in the State of New Hampshire; or 3) an authorized representative of the one of the persons listed above. Samples of each material shall be submitted to a chemical analytical laboratory, certified by the New Hampshire Department of Environmental Services.
 - c. Submit geotechnical and analytical test data and certifications for every 1000 cubic yards (every 500 cubic yards for moisture density curves) of material imported or reused on-site or anytime consistency of material changes in the opinion of the Engineer. Submit associated chemical laboratory data on the imported materials throughout the course of the Work, if requested by the Engineer, to evaluate the consistency of the source or process, at no additional cost to the Owner.
- C. During Construction, submit written confirmation of fill lift thickness, in-place soil moisture content, and percentage of compaction to the Owner's Engineer before placing the next lift or constructing foundations or structures.

1.4 QUALITY CONTROL:

- A. The Contractor shall assume full responsibility for quality control inspection and testing, give sufficient notice to the Owner's Engineer to permit the witnessing of the inspections or tests, and provide test results to Owner's Engineer within one day of completion.
- B. The Contractor shall engage a qualified, independent testing agency to perform quality control testing and inspections. Compaction testing shall be performed at the minimum frequency specified in Section 3.03D.
- C. Source of supply. No earthwork materials will be accepted on the jobsite without written approval of submittals from the Owner's Engineer, as stated in Section 1.04.
- D. The Owner's Engineer reserves the right to perform inspections and tests at any time during the execution of the work.
- E. Notification Point: The Contractor shall give the Owner's Engineer two days' notice in

advance of quality control tests and inspections.

1.5 REFERENCE STANDARDS:

A. The following standards are applicable to the work of this section to the extent referenced herein.

1. ASTM International (ASTM):

- ASTM C131 Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
- ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
- ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
- ASTM D6913 Standard Test Method Particle Size Analysis of Soils
- ASTM D6938 Test Methods for Density of Soil and Soil-aggregate in Place by Nuclear Methods (Shallow Depth).

State of New Hampshire Department of Transportation (NHDOT) Standard Specifications for Road and Bridge Construction

1.6 EXAMINATION OF SITE AND DOCUMENTS:

- A. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of a lack of knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation of the site.
- B. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them during the bidding period and formed its own conclusions as to the full requirements of the work involved.

1.7 DEFINITIONS

- A. Backfill and Fill Materials: Soil and rock material used in construction as specified herein.
- B. Structures: Buildings, concrete slabs, foundations, grade beams, pile caps, equipment

pads, manholes, below grade vaults and equipment capsules.

- C. Unsuitable Material: Include topsoil, existing undocumented fill, material containing organic silt, organic clay, peat, vegetation, wood or roots, stones or rock fragments over 6-inches in diameter, porous biodegradable matter, disturbed soils, debris, contaminated media, snow, ice or refuse. Unsuitable material also includes any materials not suitable for reuse as backfill as defined by the requirements of this Specification.
- D. Subgrade: the bottom surface of a trench or excavation extending to the underside of site improvements, including bedding materials for building foundations and slabs, pipes, structures, pavement subbase, or other surfacing material.
- E. Pass: a single complete coverage with compaction equipment over the entire surface of an exposed lift or subgrade being compacted.
- F. Zone-of-Influence: Defined by a horizontal plane extending away from the outside bottom edge of the footings, slabs, grade beams, pile caps, structures, and utilities a distance of two feet, then by a plane that slopes down and away from the foundation at a maximum 1H:1V slope to the natural inorganic soil subgrade.

1.8 EXCAVATION CLASSIFICATIONS:

- A. Earth Excavation or "Excavation" consists of removing materials encountered to the subgrade elevations indicated and subsequent reuse or disposal of the materials removed. All excavation is classified as earth excavation unless it otherwise meets the classifications provided below for unauthorized excavation, additional excavation, or rock excavation.
- B. Unauthorized Excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Owner's Engineer. Unauthorized excavation, as well as remedial work required by the Owner's Engineer, shall be at the Contractor's expense.
 - 1. Under foundations, grade beams, concrete slabs, equipment pads, or other structures, fill unauthorized excavations to the proper elevations with Structural Fill as defined herein (except where lightweight fill is required by the Engineer). Elsewhere, backfill and compact unauthorized excavations as specified for excavations of the same class, unless otherwise required.
- C. Additional Excavation:
 - 1. When excavation has reached required subgrade elevations, notify the Owner's Engineer, who will observe subgrade conditions.
 - 2. If unsuitable bearing materials are encountered at the required subgrade elevations, carry excavations deeper and to the lateral extent as required on the drawings and as required by the Owner's Engineer. Replace excavated material as required by the Owner's Engineer.
 - 3. Removal of unsuitable material and its replacement as specified is included in the base Scope of Work and shall be included in the lump sum price. Contractor shall

promptly notify the Owner and the Engineer if unsuitable material quantities represent, in the Contractor's opinion, a differing subsurface or physical condition. Any corresponding adjustment to the Contract Price and/or Contract Times shall be made in accordance with the Contract Documents.

1.9 EXCAVATION:

- A. Perform all excavations and of whatever materials encountered, in a manner as required to allow for placing of temporary earth support, dewatering, forms, installation of pipe, structures, and other work, and to permit access for the purpose of observing the work. Excavations shall be to such widths as will give suitable space for the required work. Bottoms of trenches and excavations shall be protected from frost and shall be firm, dry and in an acceptable condition to receive the work. Work shall not be placed on frozen surfaces nor shall work be placed on wet or unstable surfaces.
- B. All excavations made in open cut will be controlled by the conditions existing at that location. In no case shall earth be excavated or disturbed by machinery so near to the finished subgrade for structures and utilities as to result in the disturbance of the earth below the subgrade. The final excavation to subgrade should be accomplished with a smooth bladed bucket or by hand. Subgrades shall be observed by the Owner's Engineer prior to placement of overlying materials including fill, concrete forms, and rebar.
- C. The Contractor shall segregate and stockpile separately materials that are considered suitable for on-site re-use by the Owner's Engineer from unsuitable materials and materials requiring off-site disposal. Costs associated with off-site disposal of materials that are considered suitable for re-use by the Owner's Engineer, whether mixed with unsuitable materials or not, shall be borne by the Contractor.
- D. Temporary excavation support shall be provided in accordance with Section 31 50 00, SUPPORT OF EXCAVATION.
- E. Dewatering shall be provided in accordance with Section 31 23 19, DEWATERING.

1.10 PERMITS, CODES, AND SAFETY REQUIREMENTS:

- A. Comply with all rules, regulations, laws and ordinances of the municipality, the Commonwealth of Massachusetts, and other authorities having jurisdiction over the project site or work. All labor, materials, equipment and services necessary to make the work comply with these requirements shall be provided by the Contractor without additional cost to the Owner.
- B. Comply with the provisions of the Manual for Accident Prevention in Construction of the Associated General Contractors of America, Inc., and the requirements of the Occupational Safety and Health Administration, United States Department of Labor.
- C. The Contractor shall obtain and pay for all permits and licenses required to the complete work specified herein and shown on the Contract Drawings.
- D. The Contractor shall not close or obstruct any street, sidewalk, or passageway without written permission from authorities having jurisdiction unless otherwise indicated on the Contract Drawings. The Contractor shall conduct their operations as to minimize

interference with the use of roads, driveways, or other facilities near enough to the work to be affected by the work.

- E. The Contractor shall notify “Dig Safe” at 1-888-DIG-SAFE prior to commencing any excavation work.
- F. The Contractor shall provide police details when working in roadways as required by local jurisdictional authorities. The Contractor shall pay for any and all details.

1.11 PROTECTION OF EXISTING CONDITIONS:

- A. All work shall be executed in such a manner as to prevent any damage to existing buildings, streets, curbs, paving, service utility lines, structures at the site and adjoining properties. Protect existing improvements from damage caused by settlement, lateral movements, undermining, washout and other hazards created by earthwork operations.
- B. Locate and mark underground utilities to remain in service before beginning the work. All costs associated with protecting, maintaining, relocating, supporting, locating, digging test pits, etc. for all utilities shall be included in the bid price. Protect and support all existing utilities to remain in service during operations. Do not interrupt existing utilities except when authorized in writing by authorities have jurisdiction unless otherwise indicated on the Contract Drawings.
- C. When an active utility line is exposed during construction its location and elevation shall be recorded on the Record Drawings by the Contractor and both the Owner’s Engineer and the Utility Owner shall be notified in writing. Active utilities existing on the site shall be carefully protected from damage or relocated as required by the work.
- D. Inactive or abandoned utilities encountered during construction operations shall be removed or abandoned in place by completely filling with grout or Controlled Density Fill in a manner to prevent voids. The location of such utilities shall be recorded on the Record Drawings.
- E. Provide barricades, fences, lights, signs, and all other safety devices required to protect the public against injury.
- F. In case of any damage or injury caused in the performance of the work the Contractor shall, at their own expense make good such damage or injury to the satisfaction of, and without cost to, the Owner. Existing streets, sidewalks and curbs damaged during the project work shall be repaired or replaced to their condition prior to commencement of earthwork operations. The Contractor shall replace, at their own cost, existing benchmarks, observation wells, monuments, and other reference points, which are disturbed or destroyed.
- G. Acceptance of any of the Contractor’s plans, design calculations and methods of construction shall not relieve the Contractor of the responsibility for the adequacy of the excavation lateral support system; preventing damage to existing or new structures, utilities and streets adjacent to excavations; the safety of persons working within excavated areas and the public at large; and excavation dewatering.

1.12 DRAINAGE:

- A. The Contractor shall provide, at its own expense, adequate drainage facilities to complete all work items in an acceptable manner. Drainage shall be done in a manner so that runoff will not adversely affect construction procedures or cause excessive disturbance of underlying natural ground or abutting properties.

1.13 FROST PROTECTION AND WET WEATHER:

- A. The Contractor shall, at its own expense, keep earthwork operations clear and free of accumulations of snow as required to carry out the work.
- B. The Contractor shall protect the subgrade beneath new structures, utilities and areas of grade increases from frost penetration when freezing temperatures are expected.

1.14 DISPOSAL:

- A. All excess and unsuitable excavated soil shall be removed from the site and legally disposed off-site by the Contractor at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 BACKFILL MATERIALS:

- A. **Common Fill:** Common Fill shall be well-graded, natural inorganic soil containing no stone greater than 6 inches maximum dimension and less than approximately 20 percent fines. The materials shall be free of trash, ice, snow, tree stumps, roots and other organic and deleterious materials. It shall be free of plastic clays, of all materials subject to decay or other materials that will corrode piping or metals. Common Fill shall have a maximum dry density of not less than 110 pounds per cubic foot. It shall be of such a nature and character that it can be compacted to the specified densities. Topsoil shall not be considered Common Fill.
- B. **Gravel:** Gravel shall satisfy the requirements of NHDOT Item No. 304.2, Gravel.
- C. **Crushed Gravel:** Crushed Gravel shall satisfy the requirements of NHDOT Item No. 304.3, Crushed Gravel.
- D. **Crushed Stone Fine (aka Gravel Subbase):** Crushed Stone Fine shall satisfy the requirements of NHDOT Item No. 304.4, Crushed Stone (Fine).
- E. **Structural Fill (aka Select Backfill):** Structural Fill shall satisfy the requirements of Gravel or Crushed Gravel, above.
- F. **Crushed Stone:** Crushed Stone shall be durable, clean, angular crushed rock or stone satisfying the gradation requirements below. Crushed Stone separated from surrounding soils with Geotextile Fabric, as specified herein, may be used as Structural Fill where approved by the Engineer.

Sieve Size

Percent Finer by Weight

2"	100
1.5"	95 – 100
3/4"	35 – 70
3/8"	10 – 30
No. 4	0 – 5

- G. **Sand:** Sand shall satisfy the requirements of NHDOT Item No. 304.1, Sand.
- H. **On-Site Soils:** Existing available soil materials from on-site excavations may be reused as Common Fill or for Structural Fill provided the on-site materials meet the material requirements as described above and are approved by the Engineer.
- I. **Geotextile Fabric:** Geotextile fabric used for drainage and separation shall consist of a non-woven fabric made from polypropylene or polyethylene filaments or yarns. The fabric shall be inert to organic chemicals commonly encountered in the soil. The fabric shall conform to the following recommended property tests:

Property	Unit	Test Method	Minimum Value
Weight	oz/sy	ASTM D-5261	8.0
Grab Strength	lbs	ASTM D-4632	205
Grab Elongation	percent	ASTM D-4632	50
Trapezoid Tear Strength	lbs	ASTM D-4533	80
Mullen Burst Strength	psi	ASTM D-3786	350
CBR Puncture Strength	lbs	ASTM D-6241	500
Apparent Opening Size (AOS)	U.S. std. Size Sieve	ASTM D-4751	80

Edges of filter fabric shall overlap a minimum of one foot.

- J. **Foamed Glass Aggregate Fill:** Lightweight, processed glass material created from a mixture of crushed or granulated glass and a blowing agent (chemical foaming agent). Near the melting point of the glass, the mixture hardens into a rigid material with gas-filled closed cell pores comprising a large portion of its volume. Foamed glass aggregate (FGA) shall have the following physical properties:
1. FGA shall be made from of a minimum of 98% recycled glass.
 2. FGA shall meet the following gradation specifications .

Sieve Size	Total Percent Passing
4"	100
2 1/2"	85-100
3/8"	0-15

3. The as-delivered FGA should have a maximum dry bulk density of no more than 15 lbs/ft³. The loose bulk density of delivered FGA may be determined per ASTM C29/C29M Method C. If necessary, this value shall be adjusted by the moisture content of the FGA to determine the dry, loose bulk density. Moisture content shall be determined using ASTM D2216 or ASTM D4959 or ASTM D4643.
4. The FGA shall be made using a dry foaming process to produce a closed cell structure and shall be non-leaching.
5. The FGA manufacturer must demonstrate experience of manufacturing a minimum of 80,000 cubic yards of foamed glass aggregate meeting the requirements of this Section.
6. The FGA shall be wrapped in a nonwoven 6 oz./sy staple fiber, needle-punched, polypropylene geotextile with a minimum grab tensile strength of the geotextile shall be 160 lbs. per ASTM D4632.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS:

- A. The Contract Drawings indicate the proposed finish alignments, elevations, and grades of the work. Establish the line and grade in close conformity with the Contract Drawings. The Owner's Engineer, however, may make minor adjustments in the field as necessary due to conditions encountered.
- B. The Contractor is responsible for establishing construction phasing, means, and methods and interim grading and temporary conditions required to attain the finish product required by the Contract Documents. The Contractor is responsible for all construction, protection, movement, and maintenance of stockpiles. Establish and maintain suitable benchmarks and grade control to accurately perform the work.

3.02 EXCAVATION:

- A. Cobbles and boulders within dense well-bonded soils or other competent, naturally deposited soils and/or any other features man-made, man-placed, or natural may be encountered during construction. The Contractor shall implement appropriate means and methods to advance the excavation through these materials and be prepared (equipment readily available) to remove these materials should they be encountered. No separate measurement or payment will be made for removal of these materials.
- B. All excavation shall be performed in the dry. Excavation and dewatering shall be

accomplished by methods, which preserve the undisturbed state of the subgrade soils.

- C. No excavation is permitted below a line drawn downwards at 2 horizontal to 1 vertical from the underside of the closest edge of any in-place footing, pile cap, grade beam, or utility at a higher elevation without providing adequate sheeting and bracing (designed by a Professional Engineer in New Hampshire and retained by the Contractor) to prevent movement of the in-place footing or utility.
- D. When excavations have reached the prescribed depths, the condition of the bottom of the trench, subgrade, or foundation bearing surface shall be observed by the Owner's Engineer prior to placement of overlying materials including concrete forms and rebar. When excavating to subgrade level for pavement and hardscaping areas has been completed, the subgrade surface shall be observed by the Owner's Engineer prior to placement of overlying materials. After observation the Contractor will receive approval to proceed if conditions meet project requirements.
- E. The Contractor shall follow a construction procedure, which permits visual identification of stable ground. Where groundwater and/or surface water from the reservoir are encountered, the size of the open excavation shall be limited to that which can be handled by the Contractor's chosen method of dewatering and which will allow visual observation of the bottom and backfilling with the excavation in the dry.
- F. The Contractor shall excavate unsuitable materials to stable natural ground where encountered at proposed excavation subgrade, as required by the Owner's Engineer. Unsuitable material includes topsoil, loam, peat, other organic materials, snow, ice, debris, soft or loose soils, and trash. Unless specified elsewhere or otherwise required by the Owner's Engineer, areas where unsuitable materials have been excavated to stable ground shall be backfilled with compacted Gravel or Crushed Stone wrapped all around in non-woven filter fabric.
- G. No excavated material shall be deposited or stockpiled at any time to endanger portions of new or existing structures, either by direct pressure or indirectly by overloading areas contiguous to the operation. If there is not sufficient area available for stockpiling within the limits of the project, the Contractor will be required to furnish their own area for stockpiling.
- H. When the plans require excavation in areas in close proximity to existing buildings, roads, structures and utilities it shall be the responsibility of the Contractor at their expense to use satisfactory means and methods to protect and maintain the stability of such roads, and structures.
- I. Temporary ditches shall be made as needed to drain off surface water to avoid damaged to areas of cut or fill. Such ditches shall be maintained as required for efficient operations, at no additional cost to the Owner.
- J. The Contractor shall place a minimum of 12 inches of crushed stone wrapped in Geotextile Fabric to stabilize areas which may become disturbed as a result of rain, foot traffic, surface water runoff or groundwater seepage pressures, all at no additional cost to the Owner. The Contractor also has the option of drying materials in-place and

compacting to specified densities.

- K. Provide shoring, sheeting, and/or bracing at excavations, as required, to assure complete safety against collapse of earth at the side of excavations. Provide shoring of public utility lines where exposed in the excavations in accordance with rules and regulations of the local authorities, as no additional cost to the Owner.

3.03 FILLING AND BACKFILLING:

- A. Subgrade Preparation: The subgrades for site improvements shall be shaped to lines, grades, and cross-sections shown on the Contract Drawings and observed by the Owner's Engineer.

1. These operations shall include any required reshaping and moisture conditioning to obtain proper re-compaction of loose granular materials. All soft or otherwise unsuitable material shall be removed as required by the Engineer, and replaced with suitable material from excavation or borrow. The resulting area, and all other low sections, holes, or depressions shall be brought to the required grade with accepted material and the entire subgrade shaped to line, grade and cross-section and thoroughly compacted according to the requirements of Section 3.04. Any portion, which is not accessible to a roller, shall be thoroughly compacted by other mechanical or manual methods.
2. All subgrades must be observed and accepted by the Owner's Engineer prior to placement of Crushed Stone, Structural Fill, FGA or any structure over the subgrade. Observations will include proof-rolling with at least 4 passes of fully loaded, ten cubic yard dump truck over the subgrade or other acceptable compaction equipment subject to the approval of the Owner's Engineer. Where inaccessible, the Owner's Engineer may use steel rod probe, compaction test results or other means to evaluate the suitability of the subgrade.
3. Unsuitable soils or materials present at the subgrade level shall be over-excavated and backfilled with Structural Fill or other materials approved by Owner's Engineer.

- B. Backfill Material: Unless otherwise specified or required, the following backfill material shall be placed and compacted to lines, grades, and cross-sections shown on the Contract Drawings and observed by the Owner's Engineer:

1. Common Fill for all unpaved areas around the site except as otherwise shown in the Contract Drawings.
2. Structural Fill, as specified in Section 3.03C.3 and within one foot of finished grade below proposed pavements, and as shown in Contract Drawings.
3. Foamed Glass Aggregate (FGA), as shown in Contract Drawings.
4. In areas where the bottom of the excavation is in fine sand and silt, and is below the groundwater table, crushed stone may be placed and compacted in maximum 12-inch layers to provide a working mat and drainage layer. Filter fabric shall be placed between the crushed stone and underlying soil.

5. All crushed stone shall be separated on the top and all sides from adjacent material by geotextile fabric as specified herein.
- C. Fill Placement: Backfill shall be placed and compacted to lines, grades, and cross-sections shown on the Contract Drawings and observed by the Owner's Engineer. Compaction testing shall be performed by the Contractor's Independent Testing Subcontractor at the minimum testing frequency and the minimum compaction requirements specified in Section 3.04.
1. Maintain backfill material with a uniform moisture content, with no visible wet or dry streaking, between plus 3 percent and minus 3 percent of optimum moisture content. The final filled soil mass shall be as uniform as possible in lift thickness, moisture content, and effort required to compact soil mass. Backfill which is too wet for use shall be stockpiled, allowed to dry sufficiently, and reused by the Contractor at no additional cost to the Owner.
 2. Unless larger lifts are approved by the Owner's Engineer based on the mass and vibratory capabilities of specific compaction equipment and observed performance by the Owner's Engineer of test pad during construction, the fill thickness for each lift shall not exceed in 9-inch loose thickness.
 3. Except where FGA is specified, Structural Fill shall be placed within the zone-of-influence below proposed foundations and slabs. Structural Fill shall be placed in maximum 9-inch-thick lifts measured prior to compaction.
 4. All fills shall be placed in horizontal layers. Fill shall not be placed following the natural contours of the ground. Fill shall be placed starting in the lowest areas working up to finish grades in horizontal layers in the manner specified herein. Each layer of fill shall be benched into the existing slope in order to avoid the formation of a shear plane.
 5. Use of uncontaminated, processed and recycled demolition materials as Common Fill and backfill placement is limited to areas outside structures, outside the 'zone of influence' below foundation elements (as defined above), outside of required locations for FGA and at grades greater than 3 feet below finished subgrade elevations. Each lift shall be thoroughly compacted to at least the minimum compaction requirements stated in Section 3.04.
- D. Foamed Glass Aggregate (FGA)
1. Place geotextile and FGA at locations indicated on the drawings. The area to be filled should not have any standing water (including ice) in it prior to placement of the foamed glass aggregate.
 2. Construction equipment, other than for placement and compaction, shall not operate on the exposed foamed glass aggregate in order to minimize additional compaction of the foamed glass aggregate.
 3. For compaction using tracked equipment FGA shall be placed in uncompacted lift thicknesses of 12-inches and compaction shall be performed with a tracked

excavator or dozer with ground pressures of 625 - 1,025 psf. Compaction using tracked equipment shall be completed by placing the initial lift thickness, and then raising the blade or bucket and tracking over the layer for a total of four full passes. One full pass is defined as a minimum of 100% coverage of the tracks passing over the top of the lift.

4. For areas not accessible by tracked equipment (e.g. around structures and utilities) or to compact thinner lifts, foamed glass aggregate shall be placed in maximum uncompacted lifts of 12-inches and compacted with a plate compactor 110-220 lbs. Compaction shall be complete after a minimum of four full passes with the plate compactor.
5. The geotextile will be placed as a separator between subgrade and the initial lifts of foamed glass aggregate as well as above the final lift and on side slopes as a separator between the foamed glass aggregate and capping layer. Care should be taken during placement of capping layer to prevent damage to geotextile. Adjacent panels of geotextile may be sewn together or overlapped a minimum of 12-inches. The geotextile shall not be left exposed for longer than 14 days.

E. Trench Backfill:

1. After the utility pipe installation has been inspected and approved, trenches shall be backfilled as soon as practicable with specified material. All trench backfilling shall be done with care.
2. Backfill material for pipe bedding shall be deposited in the trench, uniformly on both sides of the pipe, for the entire width of the trench to the springline of the pipe. The backfill material shall be placed by hand shovels, in layers not more than 6-inches thick in loose depth, and each layer shall be thoroughly and evenly compacted by tamping on each side of the pipe to provide uniform support around the pipe, free from voids.
3. The balance of backfill shall be spread in layers not exceeding 9-inches in loose depth. Each layer shall be thoroughly compacted by mechanical methods and shall contain no rock, stones or boulders larger than 4-inches in their greatest dimension.
4. All trench backfilling shall be done with special care and must be carefully placed so as not to disturb the work at any time; if necessary, a timber grillage or other suitable method shall be used to break the fall of the material. The moisture content of the backfill material shall be such that proper compaction will be obtained. Puddling of backfill with water will not be permitted. Backfill within areas to receive topsoil or pavement construction shall be made to grades required to establish the proper subgrade for the placement of topsoil or pavement base courses.
5. In backfilling trenches, each layer of backfill material shall be moistened and compacted to a density as specified herein.
6. Any trenches or excavations improperly backfilled or where settlement occurs shall be reopened, to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and condition, at no

additional expense to the Owner.

7. During filling and backfilling operations, pipelines will be checked by the Owner's Engineer to determine whether any displacement of the pipe has occurred. If the observation of the pipelines shows poor alignment, displaced pipe or any other defects they shall be remedied in a manner satisfactory to the Owner's Engineer at no additional cost to the Owner.

F. Backfilling Against Structures:

1. Backfilling against masonry or concrete shall not be done until permitted by the Owner's Engineer. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking or other damage.
2. Prior to placing backfill, the areas shall be cleaned of all excess construction material and debris and the bottom of excavations shall be in a thoroughly compacted condition. In general, use Structural Fill for backfilling against structures where the finished ground surface will be pavement or sidewalks; use Common Fill where the finished ground surface will be lawn or landscaped areas.
3. Symmetrical backfill loading shall be maintained. Special care shall be taken to prevent any wedging action or eccentric loading upon or against the structures. During backfilling operations, care shall be exercised that the equipment used will not overload the structures in passing over and compacting these fills. Backfill shall be placed in 9-inches in loose depth and each layer of backfill shall be compacted thoroughly and evenly using approved types of mechanical equipment. Each pass of the equipment shall cover the entire area of each layer of backfill.
4. In compacting and other operations, the Contractor shall conduct their operations in a manner to prevent damage to structures due to passage of heavy equipment over, or adjacent to, structures, and any damage thereto shall be made good by the Contractor at no additional expense to the Owner.

G. After backfilling trenches and excavations, the Contractor shall maintain the surfaces of backfill areas in good condition so as to present a smooth surface at all times level with adjacent surfaces. Any subsequent settling over backfilled areas shall be repaired by the Contractor immediately, and such maintenance shall be provided by the Contractor for the life of this Contract, at no additional expense to the Owner.

H. The completed and approved subgrades upon which topsoil is to be placed, or pavements are to be installed, shall not be disturbed by traffic of other operations and shall be maintained in a satisfactory condition until the base and finished courses are placed. The storage or stockpiling of materials on finished subgrade will not be permitted.

I. Uniformly shape the surfaces of all areas to be graded, to the lines and grades indicated on the Contract Drawings, and as directed, including excavated and filled sections, embankments and adjacent transition areas, and all areas disturbed as a result of the Contractor's operations. The finished surfaces shall be reasonably smooth, compacted

density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier fill.

2. Fill that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be added to allow compaction to the required density.

D. Unfavorable Conditions:

1. In no case shall fill be placed over material that is frozen. In no case shall frozen soil or soil material containing frost, snow or ice be placed as backfill. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.
2. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of the day's operations. Prior to terminating work for the day, the final layer of compacted fill shall be rolled with a smooth wheeled roller to eliminate ridges of soil left by compaction equipment.

E. Compaction Control:

1. In-place density tests shall be made in accordance with ASTM D6938 as the work progresses, to determine the degree of compaction being attained by the Contractor. Any corrective work required as a result of such tests, such as additional compaction, or a decrease in the thickness of layers, shall be performed by the Contractor at no additional expense to the Owner. Additional in-place density testing shall be made at the Contractor's expense by the geotechnical testing laboratory. Testing locations shall be selected by the Owner's Engineer unless otherwise noted.
2. In-place density tests shall be performed at a minimum according to the following:
 - a. Under all Foundations – One for each independent foundation or one every 200 square feet of each lift (whichever results in more tests);
 - b. Slabs-on-Grade – One every 1,000 square feet of each lift;
 - c. Pavements – One every 2,000 square feet of each lift;
 - d. Backfill of Trenches – One test for every 100 linear feet of each lift.
 - e. General Fill – One every 5,000 square feet of each lift.
3. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.05 DISPOSAL OF SURPLUS MATERIALS:

- A. No excavated material shall be removed from the site of the work or disposed of by the Contractor unless approved by the Engineer.

- B. Surplus excavated materials, which are acceptable to the Engineer and meeting the requirements herein, shall be used to backfill normal excavations or to replace other materials unacceptable for use as backfill. Upon written approval of the Engineer, surplus excavated materials shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions; or shall be neatly deposited for other purposes as indicated by the Owner, within its jurisdictional limits; all at no additional cost to the Owner.

- C. Surplus excavated material not needed as specified above shall be hauled away and disposed of by the Contractor at no additional cost to the Owner, at appropriate locations, and in accordance with arrangements made by him. Disposal of all rubble shall be in accordance with all applicable local, state and federal regulations.

END OF SECTION

Document3

SECTION 31 05 13.22

CONTROLLED DENSITY FILL (CDF)

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Controlled Density Fill (CDF), aka Flowable Fill, is a flowable, self-consolidating, rigid setting, low density material that can be used for backfills, fills, and structural fills.
- B. Controlled Density Fill is to be used where indicated on the contract drawings or as required by the Engineer.

1.02 RELATED WORK:

- A. Section 00 31 43, PERMITS
- B. Section 01 11 00, CONTROL OF WORK AND MATERIALS
- C. Section 01 22 00, MEASUREMENT AND PAYMENT
- D. Section 01 33 23, SUBMITTALS
- E. Section 31 00 00, EARTHWORK
- F. Section 31 50 00, SUPPORT OF EXCAVATION

1.03 REFERENCES:

New Hampshire Department of Transportation (NHDOT) Standard Specifications - Subsection 520.

1.04 SUBMITTALS:

Proposed Mix Designs for the type(s) of Controlled Density Fill shall be submitted for review and approval from the Contractor's Ready Mix provider in accordance with Section 01 33 23.

PART 2 - PRODUCTS

2.01 MATERIALS:

Materials employed in the Controlled Density Fill shall meet the requirements as described in NHDOT Standard Specifications Subsection 520.

2.02 TYPE OF CONTROLLED DENSITY FILL:

Controlled Density Fill for this project shall be Class F concrete. The minimum required 28-day compressive strength shall be as required by the Engineer for the specific application.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Controlled Density Fill shall be batched at a ready mix plant and is to be used at a high or very high slump of approximately 10- to 12-inches. It shall be flowable, require no vibration and after it has been placed, and shall be excavatable by hand tools and/or small machines unless otherwise required by the Engineer.
- B. Controlled Density Fill shall be placed so as to not disturb adjacent structures, utilities or the sidewalls of trenches.
- C. Controlled Density Fill shall be installed to the limits shown on the drawings, or as required by the Engineer.
- D. Controlled Density Fill shall be protected until the fill reaches a point that it will not be disturbed or damaged by traffic or other construction activity.

END OF SECTION

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SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section specifies designing, furnishing, installing, maintaining, operating and removing temporary dewatering systems as required to lower and control water levels and hydrostatic pressures during construction; disposing of pumped water; constructing, maintaining, observing and, except where indicated or required to remain in place, removing of equipment and instrumentation for control of the system.

1.02 RELATED WORK:

- A. Section 00 31 43, PERMITS
- B. Section 01 57 19, ENVIRONMENTAL PROTECTION
- C. Section 31 00 00, EARTHWORK
- D. Section 31 50 00, SUPPORT OF EXCAVATION

1.03 SYSTEM DESCRIPTION:

- A. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from the slopes or bottom of the excavation; increasing the stability of excavated slopes; preventing loss of material from beneath the slopes or bottom of the excavation; reducing lateral loads on sheeting and bracing; improving the excavation and hauling characteristics of sandy soil; preventing rupture or heaving of the bottom of any excavation; and disposing of pumped water.
- B. Normal dewatering is defined as using conventional pumps installed in open excavations, ditches, or sumps. Special dewatering is defined as using single or two stage wellpoints, deep wells, or eductor and ejector systems installed in drilled holes or jetted in place.

1.04 QUALITY ASSURANCE:

- A. The Contractor is responsible for the adequacy of the dewatering systems. The Contractor shall retain the services of a Professional Engineer registered in the State of New Hampshire, experienced in dewatering systems, to independently evaluate the boring logs and any other soils information available to determine those areas that will require special dewatering techniques and to design the required system. The Contractor's Professional Engineer shall provide sufficient on-site inspection and supervision to assure that the dewatering is carried out in accordance with their design.

- B. The dewatering systems shall be capable of effectively reducing the hydrostatic pressure and lowering the groundwater levels to a minimum of 2 feet below excavation bottom, unless otherwise required by the Engineer, so that all excavation bottoms are firm and dry.
 - C. The dewatering system shall be capable of maintaining a dry and stable subgrade until the structures, pipes and appurtenances to be built therein have been completed to the extent that they will not be floated or otherwise damaged.
 - D. The dewatering system and excavation support (see Section 31 50 00) shall be designed so that lowering of the groundwater level within the work area does not adversely affect structures, utilities or wells outside of the work area.
 - E. Where special dewatering is used, the Contractor shall obtain at their expense the services of a registered professional engineer to investigate, design and monitor the dewatering system. The Contractor shall also furnish materials and install at least two observation wells at each excavation area. The location of the wells shall be determined in the field by the Contractor's engineer.
- 1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23, SUBMIT THE FOLLOWING:
- A. At least two weeks prior to installing the dewatering system, Contractor shall submit the attached Certificate of Design completed and signed by the Contractor, identifying the engineer responsible for design of the dewatering system. The Contractor shall also submit a schedule showing the timing of installation and operation of the dewatering system.
 - B. The Contractor shall submit to the Engineer for record purposes only, the following items bearing the Contractor's Engineer's stamp and signature, and identifying the codes and specifications followed in the design.
 - 1. Plans and description of the dewatering system, including the number, location and depth of wells, wellpoints or sumps; designs of filters to prevent pumping of fine soil; method and location for filtering and disposal of pumped water; and flow capacity of proposed system.
 - 2. Locations of observation wells.
 - C. The Contractor shall submit records of pump operation and groundwater elevations as required by the Owner's Engineer.

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.01 DEWATERING OPERATIONS:

- A. All water pumped or drained from the work shall be disposed of in a manner which will not result in undue interference with other work or damage to adjacent properties, pavements and other surfaces, buildings, slopes, structures, and utilities. Suitable temporary pipes, flumes or channels shall be provided for water that may flow along or across the site of the work. All disposal of pumped water shall conform to the provisions of Section 01 57 19, ENVIRONMENTAL PROTECTION and Section 00 31 43, PERMITS.
- B. Dewatering facilities shall be located where they will not interfere with utilities and construction work to be done by others.
- C. Dewatering procedures to be used shall be as described below:
 - 1. Crushed stone shall encapsulate the suction end of the pump to aid in minimizing the amount of silt discharged.
 - 2. Water shall not be discharged onto or above slopes.
 - 3. For dewatering operations with relatively minor flows, pump discharges shall be directed into strawbale sedimentation traps lined with filter fabric. Water is to be filtered through the strawbales and filter fabric prior to being allowed to seep out into its natural water course.
 - 4. For dewatering operations with larger flows, pump discharges shall be into a steel dewatering basin. Steel baffle plates shall be used to slow water velocities to increase the contact time and allow adequate settlement of sediment prior to discharge into waterways.
 - 5. Where indicated on the contract drawings or in conditions of excess silt suspended in the discharge water, silt control bags are to be utilized in catchbasins.
- D. The Contractor shall be responsible for repair of any damage caused by their dewatering operations, at no cost to the Owner.

3.02 SPECIAL DEWATERING:

- A. If conventional dewatering methods are inadequate to ensure dry and stable conditions for site excavations, the Contractor shall be required to use special dewatering as necessary.
- B. Special dewatering techniques may consist of one or two stage wellpoint systems, deep wells, or eductor and ejector type systems. The Contractor shall utilize a system which

provides proper construction conditions and prevents settlement at time of installation and upon backfilling.

- C. In areas requiring special dewatering, the Contractor shall lower the groundwater level to a minimum of 2 feet below the bottom of the final excavation grade prior to excavation. Groundwater levels shall be confirmed by monitoring well observations prior to construction. The control shall maintain that groundwater level until the excavation has been backfilled. The groundwater levels shall be monitored by the Contractor's engineer to ensure conformance with the requirements of these specifications. Construction will not be allowed until the Owner's Engineer is satisfied that the above provisions are met.

END OF SECTION

(Certificate of Design follows this page)

CERTIFICATE OF DESIGN

Re: Contract Between:

OWNER: _____
(Name)

and
CONTRACTOR: _____
(Name)

on
CONTRACT: _____
(Number)

Date: _____

Title: _____

Contractor hereby certifies that _____:
(Engineer)

1. Is licensed or registered to perform professional engineering work in the state of _____;
(Location of Project)
2. Is qualified to design the _____
(Item)
specified in Section _____ of subject contract;
3. Has designed _____ before;
(Item)
4. Has prepared the design in full compliance with the applications and requirements of Section _____ of subject contract including all applicable laws, regulations, rules, and codes; and
5. The work has been signed and sealed pursuant to applicable state law.

FOR: _____
(Contractor)

BY: _____
(Signature)

(Name and Title)

Dated: _____

SECTION 31 50 00

SUPPORT OF EXCAVATION

PART 1 – GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers soldier pile and lagging systems for support of excavations. The requirements of this section shall also apply, as appropriate, to other methods of excavation support and underpinning which the Contractor elects to use to complete the work.
- B. Use of vibratory or impact hammers to install support of excavation systems is prohibited.
- C. The Contractor shall furnish, place and maintain such shoring and bracing at locations necessary to support the sides of excavations to prevent danger to persons or damage to adjacent pavements, facilities, utilities, or structures; to prevent injurious caving or erosion or the loss of ground; and to maintain pedestrian and vehicular traffic as required by the Contract Documents, the Contractor's sequence of construction, and as required by the Engineer.
- D. In all shoring and bracing operations, care shall be taken to prevent collapse of excavations, injury to persons or damage to adjacent structures, facilities, utilities and services. Any injuries to persons shall be the responsibility of the Contractor; and any damage to the work occurring as a result of settlement, water or earth pressure, or other causes due to inadequate bracing or other construction operations of the Contractor shall be satisfactorily repaired and made good by the Contractor, at no additional expense to the Owner.
- E. The Contractor shall comply with all federal, state, and local safety regulations and requirements.
- F. Routine monitoring of the in-place excavation support system shall be provided.

1.02 RELATED WORK:

- A. Section 00 31 32, SUBSURFACE DATA
- B. Section 31 00 00, EARTHWORK
- C. Section 31 23 19, DEWATERING

1.03 QUALITY ASSURANCE:

- A. This is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926. Contractors shall understand and comply with the requirements of these regulations.

- B. The Contractor is responsible for the adequacy of the excavation support system and shall retain the services of a Professional Engineer registered in the State of New Hampshire to design the required excavation support systems. The Contractor's Professional Engineer shall practice in a discipline applicable to excavation work, shall have experience in the design of excavation support systems and shall design in conformance with OSHA requirements. The Contractor's Professional Engineer shall provide sufficient on-site inspection and supervision to assure that the excavation support system is installed and functions in accordance with their design. Criteria listed herein defining the responsibilities of the Contractor's Professional Engineer are minimum requirements.

1.04 REFERENCES:

The following standards form a part of this specification as referenced herein.

American Society for Testing and Materials (ASTM)

ASTM	A6	General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
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1.05 SUBMITTALS:

- A. At least three weeks before starting installation of the excavation support system, the Contractor shall submit the attached Certificate of Design completed and signed by the Contractor and the Professional Engineer, identifying the Contractor's Professional Engineer who will be responsible for design of the excavation support system, and including, for record purposes only:
 - 1. An overall time schedule for construction of the braced excavation system.
 - 2. A description of the anticipated sequence of construction.
 - 3. Three (3) copies each of:
 - a. Complete details of braced excavation methods, equipment and sizes and lengths of materials proposed to be used, and a plan showing the locations of all support of excavation systems relative to existing and proposed site features.
 - c. Details of the means and methods that will be used in monitoring the integrity of the support system during its entire period of use to ensure the safety of the excavation.
 - d. Complete computations for the design of the braced excavation system bearing the seal of the responsible Professional Engineer duly registered licensed to practice within a discipline applicable to excavation work, in the State of New Hampshire.

- e. Any other pertinent data required for record purposes by the Engineer.
- B. Receipt of the information by the Engineer will not relieve the Contractor of the sole responsibility for the adequacy of the support of excavation system, and for assuring that there will be no resulting damage to adjacent pavement, utilities or structures, and for providing safe conditions within the sheeted areas.
- C. Further for the record, upon completion of the work of this section, the Contractor shall submit 3 copies of all records of survey and inspection of existing structures to the Owner's Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Where soldier piles and lagging are used, the steel piles shall conform to ASTM A6, and the lagging shall meet the requirements for timber sheeting, as defined above.
- B. Timber and steel used for bracing shall be of such size and strength as required in the excavation support design prepared and submitted by the Contractor's Professional Engineer. Timber or steel used for bracing shall be new or undamaged used material, which does not contain splices, cutouts, patches, or other alterations, which would impair its integrity or strength.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Work shall not be started until all materials and equipment necessary for construction are either on the site of the work or satisfactorily available for immediate use as required.
- B. The shoring shall be sufficiently tight to minimize any resulting lowering of the groundwater level outside the excavation, as required in Section 31 23 19, DEWATERING.

3.02 Soldier Piles and Lagging

- A. Install vertical steel soldier piles before starting excavation at element spacings and design depths indicated on the reviewed shop drawings. Install soldier piles in holes drilled full depth with temporary casing. Driving by impact or vibratory hammers will not be allowed. Drilled methods shall prevent loss of ground around the hole.
- B. Each soldier pile shall be installed in its drilled hole within 2 hours after drilling is completed to the required depth. Install piling in plumb position such that each installed pile is in line with adjacent piles over its entire length. Piles shall be installed in a drilled hole and held in place during backfilling.

- C. The Contractor shall have equipment on-site capable to advance the drilled hole, for installation of the soldier piles, through sand below the water table, and through large boulders and other obstructions which may be encountered.
- D. Space soldier piles at regular intervals not to exceed allowable flexural strength of lagging. Accurately align exposed faces of flanges to vary not more than 2-inches from a horizontal line and not more than 1:120 out of vertical alignment.
- E. Within the same day of seating the soldier piles in the drilled holes, encase the piles with Structural Concrete to the excavation depth. If alternate encasement material below the excavation zone is proposed by the Contractor, the axial load carrying capacity of the embedded portion of vertical wall elements (below the base of the excavation) shall be evaluated. The wall shall be designed to resist vertical loads including vertical anchor forces, the weight of the lagging and the vertical wall elements. Relying on transfer of vertical load into the soil behind the wall by friction shall not be permitted, unless approved by the Owner's Engineer.
- F. Backfill with Lean Concrete or CDF above the excavation elevations to the currently existing ground surface. Crushed stone or other granular materials are not acceptable.
- G. Prior to completion of the final backfilling operations, soldier piles shall be cut off 4 feet below the final ground surface unless otherwise required by the Owner's Engineer.
- H. Install wood lagging within flanges of soldier piles as excavation proceeds in a manner that will prevent loss of soil. Trim excavation as required to install lagging. The sheeting/lagging shall be sufficiently tight to minimize any resulting lowering of the groundwater level outside the excavation, as required in Section 31 23 19, DEWATERING. As installation progresses, backpack the voids between the excavation face with sand and on-site soils to establish a tight contact. Pack louver openings between lagging with hay or other porous material to allow free drainage of groundwater without loss of retained soil or backpacking. In no case shall the louvered openings be allowed to exceed 1-inch.
- I. Beginning at the top of the soldier piles, the maximum permissible height of unlagged face of excavation shall not exceed 2-feet in all soil types encountered at the site. If water is flowing from the face of the excavation, or if soil to be retained moves toward the excavation, the maximum height of unlagged face shall not exceed 8-inches.
- J. If unstable ground is encountered, take suitable measures (grouting behind the lagging or other approved method) to retain the material in place and prevent loss of ground or movements, which may cause damage to adjacent structures or utilities.
- H. All cut-off material is the property of the Contractor and shall be promptly removed by it from the site.
- I. The satisfactory construction and maintenance of the excavation support system, complete in place, shall be the responsibility of the Contractor.

- J. The Contractor shall be responsible for promptly repairing all damage to adjacent structures caused by the installation, performance, or removal of the excavation support system.

END OF SECTION

(Certificate of Design follows this page)

CERTIFICATE OF DESIGN

RE: Contract between
 OWNER: _____
 and (Name)
 CONTRACTOR: _____
 on (Name)
 CONTRACT: _____
 (Title)

 (Number) (Date)

The undersigned hereby certify that the engineer listed below:

1. Is licensed or registered to perform professional engineering work in the state of _____;
 (Location of Project)
2. Is qualified by education and training to design the _____
 specified in Section _____ of subject contract;
3. Has previously designed comparable excavation support systems;
4. Has prepared the design in full compliance with the requirements of subject contract, including all applicable laws, regulations, rules, and codes; and
5. Will inspect and supervise installation of the excavation support system and will monitor the in-place system to confirm that the system is installed and functions in accordance with the design.

CONTRACTOR

ENGINEER

By: _____
 (Signature)

By: _____
 (Signature)

 (Name)

 (Name)

 (Title)

 (Engineering Discipline)

 (Date)

 (Date)

SECTION 31 63 33

DRILLED MICROPILES

PART 1-GENERAL

1.01 SUMMARY:

- A. Work under this section consists of furnishing all necessary supervision, labor, materials, and equipment required for the design and installation of cement grouted, drilled-in micropiles as shown on the Contract Drawings and as specified herein.
- B. The micropile specialty Contractor (referred to hereafter as “Contractor”) shall visit the site prior to mobilization of equipment to the site to observe and review specific site conditions, access conditions, requirements for equipment, and to evaluate methods and costs to install micropiles.
- C. The Contractor is responsible for furnishing all materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for installation and testing of micropiles and pile top attachments for this project.
- D. The Contractor is responsible for designing drilled micropiles installed with permanent casing extending through the non-frictional resistance zone comprised of fill, sand, and clay, and a minimum of 5 feet below the top of the frictional resistance zones comprised of bedrock. Within the design bearing strata, the micropiles shall be designed as uncased, frictional micropiles with full length reinforcing steel and grout.
- E. The Contractor shall design and install micropiles that will develop the loads capacities indicated on the project plans. The micropile load capacities shall be verified by load testing as required by this Section. The Contractor shall conduct at least one static verification load test.
- F. The allowable geotechnical capacity as determined by the load test of the micropile shall include a minimum factor of safety of 2.0.
- G. Protect existing structures in accordance with the requirements of authorities having jurisdiction over the adjacent structures and utilities.

1.02 RELATED WORK:

- A. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by the Work of this Section. A list of those Documents and Sections includes, but is not limited to, the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 General Requirements Specification Sections, apply to this Section.

2. Section 00 31 32 - SUBSURFACE DATA
3. Section 01 33 32 – SUBMITTALS
4. Section 03 30 00 – CAST-IN-PLACE CONCRETE
5. Section 05 12 33 – STRUCTURAL STEEL
6. Section 31 00 00 – EARTHWORK

1.03 REFERENCES:

- A. The following standards are applicable to the work of this section to the extent referenced herein:

1. American Petroleum Institute (API)

API RP-13B-1 – Recommended Practice for Field Testing Water-Based Drilling Fluids
2. ASTM International (ASTM)
ASTM A36 – Structural Steel
ASTM A252 – Welded and Seamless Pipe Piles
ASTM A615 – Deformed and Plain Billet Steel Bars for Concrete Reinforcement
ASTM A722 Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM A775 – Epoxy-Coated Reinforcing Steel Bars
ASTM C109 – Test Method for Compressive Strength of Hydraulic Cement Mortars Using 2-inch Cube Specimens
ASTM C150 – Standard Specification for Portland Cement, Type II
ASTM C404 – Aggregates for Masonry Grout
ASTM C494 – Chemical Admixtures for Concrete
ASTM D1143 – Method of Testing Piles Under Static Axial Compressive Load
3. Federal Highway Administration (FHWA)

FHWA NHI-05-039, Micropile Design and Construction Reference Manual, 2005
4. New Hampshire State Building Code

1.04 PROJECT SITE AND SUBSURFACE CONDITIONS:

- A. Refer to Section 00 31 32 SUBSURFACE DATA for information on site and subsurface conditions.
- B. Micropiles will be installed adjacent to the existing wet well. The Contractor shall be prepared to implement methods to protect the existing wet well and associated piping from damage. Driving of casing and external flushing is prohibited.

- C. The following minimum design guidelines shall be used:
 - 1. Micropile and pile top to footing connection shall be designed using the procedures in the FHWA “Micropile Design and Construction, Report No. FHWA NHI-05-039.
 - 2. Micropiles shall be designed as friction piles developing their support entirely in friction in the bedrock bond zone. End bearing shall be neglected.
 - 3. Micropiles shall be designed using a minimum factor of safety of 2.0, as confirmed by successful completion of static load testing as specified herein.
 - 4. Micropiles shall not be installed using auger cast pile methods.
- D. The Contractor shall be aware that remnants of old foundations and other buried structures and naturally deposited cobbles and boulders may exist within the work area and may be encountered. The Contractor is responsible for removal or penetration of obstructions.

1.05 SUBMITTALS – IN ACCORDANCE WITH SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING

- A. Submittals shall be delivered to the Owner’s Representative/Engineer a minimum of 45 calendar days prior to micropile installation. Work shall not begin until the appropriate submittals have been received, reviewed, and approved in writing by Owner’s Representative/Engineer.
- B. Review of the submittals by the Owner’s Representative/Engineer will not relieve the Contractor of the responsibility to provide and safely install micropiles capable of supporting the design loads specified herein.
- C. Contractor’s Qualifications: The Contractor performing the work in this Specification shall have installed micropiles for a minimum of five (5) years on similar projects. At the time of the bid, the Contractor shall submit:
 - 1. A list containing at least five (5) comparable installations on which the Contractor and the Superintendent have installed micropiles. A brief description of key project drilled pile features; time period (dates) when drilled pile work was performed and ultimate client’s name; direct client contact name, address, telephone number and email address shall be included for each project. The Contractor may not use consultants or manufacturer’s representatives to meet the requirements of this section.
 - 2. Resume of Project Superintendent including pertinent project experience.
 - 3. Resume of Contractor’s micropile design Engineer.
- D. Prior to the start of work, the Contractor shall submit a list identifying the drill operators and on-site supervisors who will be assigned to the project. Drill operators and on-site supervisors shall have a minimum of one (1) year experience installing micropiles with the Contractor’s organization.

E. Shop Drawings:

1. The Contractor's Engineer shall submit for approval, structural and geotechnical design calculations and drawings for the proposed micropile foundation system, sealed by a Registered Professional Engineer currently licensed in the State of New Hampshire. Micropiles shall be designed to support the structural loads indicated on the Drawings. As a minimum the micropile design calculations shall include:
 - a. Detailed summary of design assumptions
 - b. Applicable code and design references
 - c. A figure with micropile identification numbers, reference baseline and elevation datum.
 - d. Details of proposed micropile type, diameter, cased and uncased zones, including soil/rock strata and grout to ground bond values.
 - e. Micropile design axial and lateral capacity calculations, addressing both geotechnical and structural capacities of the micropile elements
 - f. Type and size of reinforcing steel
 - g. Total micropile length, and minimum embedment lengths in bedrock for frictional resistance
 - h. Combined stress calculation for cased section, cased section at threaded joints, and uncased section
 - i. Bearing and tension plate calculations
 - j. Top of micropile connection details.

F. The Contractor or Contractor's grout supplier shall submit detailed information about the proposed grout mix to Owner's Representative/Engineer. The information shall include:

1. Mix proportions and evidence the proposed mix provides adequate strength and uniform consistency of grout.
2. Type, manufacturer, and chemical composition of grout
3. Type, manufacturer or source, and purposes of admixtures
4. Gradation, fineness modulus, and source of fine aggregates
5. Certification of grout mix materials to be in compliance with "Applicable Standards," including cement, aggregate, and all admixtures

G. Certified mill test reports, properly marked, for the reinforcing steel, as the materials are delivered, to Owner's Representative/Engineer for record purposes. The ultimate strength, yield strength, elongation, and composition shall be included. For steel pipe used as permanent casing, or core steel, the Contractor shall submit a minimum of two representative coupon tests or mill certifications (if available) on each load delivered to the project.

H. Proposed Work Plan providing step-by-step procedures for micropile installation, including:

1. Details on spoils management

2. Proposed equipment and techniques for micropile installation, including rig name, model number, proposed drill attachments, and special equipment for proposed installation method.
 3. Detailed sequence of excavation and steel casing installation, water or air flushing, reinforcing steel placement, and grout injection. Identify the planned drilling technique(s) in accordance with FHWA NHI-05-039 Micropile Design and Construction Reference Manual.
 4. Methods to prevent caving, if necessary
 5. Method of advancing the hole through soil, including cobbles and boulders, glacial deposits, and bedrock,
 6. Procedures for supporting and centering reinforcing steel and steel casing during grout placement,
 7. Plan describing how surface water, drill flush and excess grout will be controlled and disposed. The Contractor shall not allow discharge of any materials from the installation of micropiles to enter surrounding water bodies.
 8. If welding of casing is proposed, submit the proposed welding procedure, certified by a qualified welding specialist. Lap splicing or welding of longitudinal reinforcing bars shall not be permitted.
 9. Cement grout or concrete design mix including admixtures to be used in the mix. Identify planned grout cube or concrete cylinder samples as required herein and relate samples to the construction sequence.
 10. Method of pressure grouting the annular space between the permanent casing and the drill hole as the temporary casing is withdrawn, if temporary casing is used.
 11. Methods to ensure quality control.
- I. Detailed plans for the proposed micropile load testing method. This shall include all drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity, and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads and pile top movements in accordance with this specification.
1. Calibration reports and data for each test jack, pressure gauge and master pressure gauge and electronic load cell to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within 90 calendar days of the date submitted. Testing shall not commence until the Owner's Representative/Engineer has reviewed and approved the jack, pressure gauge, master pressure gauge, and electronic load cell calibration data.
 2. Reaction load frame shall be capable of safely supporting 125 percent of the maximum test load. Structural design calculations shall be sealed by a Registered Professional Engineer currently licensed in the State of New Hampshire.
- J. Within 3 days after completion of the verification, a load test report shall be submitted to the Owner's Representative/Engineer for review within 3 days of completion of the verification load test. The load test report shall include:
1. Test pile installation log(s) with the information as required in Item 1.05-K.1

2. Information on the load test including, at a minimum, the load testing sequence, rates and durations of load increments, equipment calibrations, graphical and tabular measurements of deflection versus applied load, and drawings indicating the test pile and reaction pile locations.
3. Comparison of the load test data to the Acceptance Criteria provided in **Item 3.07-J.7** and statement regarding the load carrying capacity of the pile relative to the design loads.
4. The submittals shall be prepared by, signed, and sealed by a Professional Engineer registered in the State of New Hampshire.
5. Production pile installation shall not begin prior to review of the proof load test report by the Owner's Representative/Engineer.

K. As-Built Records:

1. The Contractor shall submit micropile installation logs within 24 hours of installations, which shall include:
 - a. pile identification number, dimensions (diameter, wall thickness, and length of steel casing; center bar type, size, and length; top and bottom elevations), cutoff and tip elevation, verticality information,
 - b. any deviation from specified location,
 - c. description of soil/ water/ obstructions encountered, length and descriptions of bonded zone,
 - d. grouting records including time and amount of grout used including maximum and average pump pressures, grout samples taken, finished grout head, re-drill and re-grout records.
 - e. Installation logs shall also include remarks concerning unusual installation behavior or conditions of the micropile.
 - f. Elevations and distances shall be provided to the nearest 0.1 ft.
2. The Contractor shall submit within 30 calendar days after completion of the micropile work a report containing:
 - a. "As-constructed" drawings showing the location and designation number of the micropiles sealed by a surveyor as specified herein,
 - b. Steel manufacturer's mill test reports for the steel pile components incorporated in the installation.
 - c. Micropile installation logs for each pile.

1.06 INSTALLATION TOLERANCES:

- A. Micropiles shall be plumb or battered within 2 percent of total-length plan alignment.
- B. The center of the micropile head shall not vary from plan location at cutoff by more than 2-inches.
- C. Acceptable tolerance of top of micropile from indicated cutoff elevation shall not be more

than ½-inch. The Contractor may elect to trim micropiles to cutoff elevation after the pile cap is excavated.

- D. Centerline of core reinforcement shall not be more than ¾-inch from centerline of piling.

1.07 QUALITY CONTROL:

- A. The Contractor shall employ a Registered Professional Engineer in the State of New Hampshire to design the drilled micropiles, load test set-up and instrumentation for pile load tests; monitor, record and evaluate test results; and prepare reports on pile load tests. The Contractor's Engineer shall have at least five (5) years of experience in drilled micropile design, installation and pile load tests setup, monitoring and analysis.
- B. Work shall always be directly supervised by an approved, experienced Project Superintendent with at least three (3) years of recent supervision experience on similar projects, constructed with similar methods and in similar ground conditions.
- C. Employ a Surveyor licensed in the State of New Hampshire to survey as installed micropile locations. The Surveyor shall be responsible for establishing the correct plan location of each pile in the field and shall determine and certify the actual location of each pile as installed, including a determination of the deviation(s) of the center of each pile from the plan location. Establish and be responsible for the protection and maintenance of project benchmarks.
- D. The Owner's Representative/Engineer will observe the Contractor's micropile installation. The Contractor shall cooperate with the Owner's Representative/Engineer in all respects to facilitate any testing or observations.
 - 1. The presence of the Owner's Representative/Engineer shall not relieve the Contractor of its responsibility to perform the Work in accordance with the approved submittals and contract documents, nor shall it be construed to relieve the Contractor from full responsibility for the means and methods of construction, protection of site improvements against damage, and for safety on the construction site.
- E. The Contractor shall adhere to the applicable requirements of the Standard Specifications, OSHA Standards, and to all other applicable ordinances, codes, statutory rules, and regulations of federal, state, and local authorities having jurisdiction over the Work of this Section.
- F. Work not in conformance with the specified requirements shall be improved, or removed and replaced, at no additional cost to the Owner. All costs related to testing of nonconforming Work or materials shall be paid for by the Contractor, at no additional cost to the Owner.
- G. The Contractor shall employ an experienced, independent testing agency to obtain grout cube samples and perform grout testing.
 - 1. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Owner's

- Representative/Engineer for final acceptance.
2. If, as a result of these tests, it is determined that the specified grout properties are not being obtained, the Owner's Representative/Engineer may require such changes in proportions or materials, or both, as may be necessary to secure the specified properties, at no additional expense to the Owner.
 3. Provide at no additional expense all materials, labor, and services for sampling and testing required by the Owner's Representative/Engineer, including but not limited to:
 - a. Preparation, handling, storage and transportation of concrete test specimens as required by the Owner's Representative/Engineer.
 - b. Suitable containers for the storage, curing and transportation of concrete test specimens in accordance with ASTM C 31.
 - c. Suitable storage for a supply of grout cube molds, test equipment and other items required for sampling and testing.
- H. All welding shall be performed by operators who have been previously qualified by tests as prescribed in the AWS. Evidence that welders meet qualification requirements shall be submitted to the Owner's Representative/Engineer before welding begins.

PART 2 – PRODUCTS

2.01 DRILLING EQUIPMENT:

- A. Drilling equipment shall be a type and capacity suitable for installing piles as indicated.
- B. Equivalent backup drill rig and equipment shall be available and on site within 7 calendar days if micropile rig or its equipment is not operational.

2.02 MATERIALS:

A. Cement Grout

1. Strength – Cement-based grout shall consist of a mixture so proportioned to produce a hardened mortar with a minimum compressive strength in 28 days of 4,000 psi or greater as determined by the Contractor's mix design, and as referenced to ASTM C125.
2. Cement shall meet the requirements provided in Section 03 30 00, Cast-in-Place Concrete.
3. Water shall meet the requirements provided in Section 03 30 00, Cast-in-Place Concrete.
4. Admixtures shall meet the requirements provided in Section 03 30 00, Cast-in-Place Concrete. Admixtures which control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to the review and acceptance by the Owner's Representative/Engineer. Admixtures shall only be added to the grout used for filling sealed encapsulations. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. The

use of admixtures will only be permitted after appropriate field tests on fluid and set grout properties. Admixtures with chlorides shall not be permitted.

5. Fillers – Inert fillers such as sand may be used in the grout in special situations (e.g., presence of large voids in the ground, when grout take and travel are to be limited) as approved by the Owner’s Representative/Engineer.
6. Mixing
 - a. Mix the cement grout with approved equipment and accurately measure all materials by volume or weight per the Contractors’ mix design. The grouting equipment shall produce a colloiddally mixed grout free of lumps and undispersed cement. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer shall be capable of continuous agitation of the grout.
 - b. Mixing time shall not be less than one minute producing a homogeneous grout. The Contractor shall perform mud balance tests on at least 25% of grout batches, or as otherwise required by the Owner’s Representative/Engineer.
 - c. The grout shall have a maximum temperature of 95°F.
 - d. Place grout within 45 minutes after mixing. This period may be extended to 60 minutes or longer as approved by the Owner’s Representative/Engineer.

B. Steel Casing:

1. Steel casing shall meet the requirements of N-80 – API Specification with a minimum yield strength of 80,000 lb./in².
2. Steel casing may be new “structural grade” (a.k.a. “mill secondary”) steel pipe meeting above but without mill certification, free from defects (dents, cracks, tears) and with two coupon tests per truckload.
3. Minimum outside diameter and wall thickness of steel casings shall be as indicated on the approved shop drawings.
4. The steel casing tip shall be open-ended.
5. Store steel casing on platforms, skids, or other supports at the site and support to prevent excessive deflection.

C. Reinforcing Steel:

1. Reinforcement shall be high strength; ASTM A615, Grade 75 Thread bar, continuous without splices or welds, new straight, and undamaged.
2. Threading may be continuous spiral deformed ribbing provided by the bar deformations (continuous thread bars) or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, provide the next-larger bar number designation from the shown plans, at no additional cost.

D. Reinforcing Steel Splice Couplings: Couplings shall develop at least 125 percent of the specified yield strength of the rebar in compression and tension. No lap splices shall be used.

E. Plates and Shapes: Refer to requirements in Section 05 12 33, Structural Steel.

F. Centralizers: Centralizers shall be fabricated from plastic, steel, or material that is non-

detrimental to the reinforcing steel. Wood shall not be used.

G. Corrosion Protection

1. Sacrificial steel – Unless otherwise noted, the structural analysis of permanent steel casing used as reinforcing steel shall consider a reduction in the outer casing wall thickness to account for sacrificial steel as corrosion protection.
2. Epoxy Coating – If used as an alternative corrosion protection method to sacrificial steel, the thickness of coating applied electrostatically to the reinforcing steel shall be 7-12 mils. Epoxy coating shall be in accordance with ASTM A775 or ASTM A936. Bend test requirements shall be waived. Epoxy coating is not required on bearing plates and nuts encapsulated in the pile concrete cap unless the cap reinforcement is epoxy coated.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS:

- A. Install the micropiles only in the presence of the Owner's Representative/Engineer. Provide a minimum of 48 hours' notice to the Owner's Representative/Engineer that their presence is required.
- B. The Contractor is responsible for determining the viable drilling technique(s) for the project conditions, including considerations of access, support of equipment, and space constraints. Changes made to the drilling techniques during the project shall not be cause for delay or impact claims.
- C. Spoils from micropile installation shall be managed in accordance with all applicable project specific, state, and federal requirements.
- D. Install in general accordance with FHWA NHI-05-039 Micropile Design and Construction Reference Manual.
- E. Sequence of permanent casing installation, drilling of bond zone, central reinforcing steel placement, grout injection, and removal of temporary casing procedures used for production piles shall be consistent with the sequence used for test pile installation operations.
- F. All installation techniques shall be determined and scheduled such that there will be no damage to micropiles in which the grout has not achieved final set.
- G. The Contractor shall control and properly dispose of drill fluids and construction related waste, including excess grout, in accordance with any related specifications within the contract documents and all applicable codes and regulations.
- H. During construction, the Contractor shall observe the ground conditions in the vicinity of the micropile construction site daily for signs of ground heave or subsidence. Immediately notify the Owner's Representative/Engineer if signs of movement are observed. The micropile Contractor shall immediately suspend or modify drilling or grouting operations if ground heave or subsidence is observed, if the micropile structure is adversely affected, or if adjacent structures are damaged from the drilling or grouting.

If the Owner's Representative/Engineer evaluates that the movements require corrective action, the micropile Contractor shall take corrective actions necessary to stop the movement or perform repairs.

- I. Notify the Owner's Representative/Engineer immediately of any damage or deviation that may affect the acceptability of the micropile so that corrective measures, if required, may be carried out with a minimum of delay.
- J. The following will be sufficient cause for the rejection of micropiles by the Owner's Representative/Engineer:
 - 1. Deviation from location or vertical alignment requirements specified herein.
 - 2. The micropile bonding zone is not within the correct strata and/or has insufficient bond length.
 - 3. Installation methods not approved by Owner's Representative/Engineer.
 - 4. Inadequate grout strength.
- K. Correct, abandon, and/or replace rejected micropiles to the satisfaction of the Owner's Representative/Engineer. Replace at no cost to the Owner.
- L. Provide the Owner's Representative/Engineer free and safe access to the work areas at all times.

3.02 INSTALLATION:

- A. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to the overburden, any overlying or adjacent structures, buried structures or utilities, or services. Casings that fail, fracture, or otherwise distort during drilling or after drilling shall, unless otherwise required by the Owner's Representative/Engineer, be withdrawn or replaced at the micropile Contractor's expense. The drill hole must be open along the full length to at least the design minimum drill hole diameter prior to placing grout and reinforcement.
- B. Provide permanent steel casing during drilling. Driving of casing and/or the use of vibratory hammers will not be allowed. Drilling shall be performed such that the cuttings and wash fluid return through the inside of the casing. External flush will not be allowed. The method of drilling used shall prevent the loss of ground due to erosion, jetting, or blow-in at the bottom of the casing. No open-hole drilling will be allowed except where advancing micropiles into weathered rock or bedrock, or as accepted by the Owner's Representative/Engineer. Use of drilling fluid containing bentonite is not allowed.
 - 1. Flush hole with water or slurry prior to installing reinforcing steel or cement grout until all contaminated water and cuttings are removed and a clean return is observed. Use an internal circulation method which will not alter soil stability or aggravate existing environmental conditions.
 - 2. The Contractor shall verify the minimum design nominal hole diameter as determined by outside diameter of casing, unless the Contractor can verify that a larger diameter is developed by installation techniques.

- C. Place cement grout by tremie method in accordance with PTI "Recommended Practice for Grouting of Post-Tensioned and Prestressed Concrete" as applicable. Place tremie pipe to bottom of the micropile. Maintain tremie pipe at least five feet below grout surface until the casing is filled with grout to cut-off elevation.
- D. The central reinforcement steel with centralizers shall be lowered into the stabilized drill holes to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. The Contractor shall re-drill and re-insert reinforcing steel when necessary to facilitate insertion.
- E. Install reinforcing steel with centralizers to the full depth of micropile at time of grouting. Provide reinforcing steel couplings, if required. Centralizers shall be placed along the entire length of micropile no greater than 10 feet apart and no less than 4 per micropile. The uppermost and lowermost centralizers shall be located at a maximum of 3 feet from the ends of the reinforcement bar. Centralizers shall permit the free flow of grout without misalignment of the reinforcement.
- F. Grouting of a micropile shall be completed on the same day that the micropile is drilled. Obtain grout samples from the end of the tremie grout line for each micropile. Grout specimens will be prepared and tested by the Contractor or their representative, in accordance with ASTM C109.
- G. Place at least 100 percent of the theoretical volume of grout based on the inside diameter of the casing through permanently cased lengths and outside nominal diameter of the drill hole through the bond zone. Notify the Owner's Representative/Engineer immediately if the actual grout take is less than the theoretical volume of grout.
- H. The Contractor shall monitor and record the amount and rate of water and/or compressed air used during the pressure injection drilling.

3.03 GROUTING:

- A. The Contractor shall provide the necessary systems, equipment, and manpower to measure the grout quality, quantity, and pumping pressure during the grouting operations.
- B. After drilling, the hole shall be flushed with water to remove drill cuttings and/or other loose debris. The Contractor shall provide a stable, homogeneous neat cement grout or a sand cement grout with the minimum 28-day compressive strength as specified herein. The grout shall not contain lumps or any other evidence of poor or incomplete mixing. Admixtures, if used, shall be mixed in accordance with manufacturer's recommendations. The pump shall be equipped with a pressure gauge to monitor pressures. The pressure gauge shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used by the Contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The grout shall be kept in constant agitation prior to pumping.
- C. Cement Grout Compression Tests:
 - 1. The Contractor shall cast two sets of six test cubes (1-inch x 2 inches x 2 inches) per rig per day, and generally representing one set of morning and one set of

afternoon installation activities for each drill rig. Cubes shall be cast and tested in accordance with the provisions of ASTM C109.

2. Two cubes shall be tested in compression at each of the ages of 7 days, 28 days, and two retained for testing at 56 days, if the need is so determined.
 3. Grout consistency as measured by grout density shall be determined per API RP-13B-1 at a frequency of at least one test per micropile, conducted just prior to start of pile grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout.
 4. Provide grout cube/cylinder compressive strength and grout density test results to the Owner's Representative/Engineer within 24 hours of testing.
- D. The grout shall be injected from the lowest point of the drill hole until clean, pure grout flows from the top of the micropile. The grout may be pumped through grout tubes or drill rods. After tremie grouting, all grouting operations including extraction of temporary drill casing and pressure grouting must ensure complete continuity of grout column. The use of compressed air to directly pressurize the fluid grout is not permissible. The grout pressures and grout takes shall be controlled to prevent excessive heave in cohesive soils or fracturing of soil or rock formations. The entire micropile shall be grouted above the design cut-off level to provide for shrinkage.
- E. Upon completion of grouting for Type A and B piles (as defined by FHWA NHI-05-039), the grout tube may remain in the hole, but it shall be filled with grout. For Type C and D piles, grout tubes shall be installed prior to the tremie grouting. If the Contractor uses a post-grouting system, all relevant details including grouting pressure, volume, location and mix design, shall be included in the pre-construction submittals.
- F. Place grout without excessive duration or delay in one continuous operation to the required cutoff elevation, to preclude the possibility of grout setting up prior to the completion of micropile placement or cold joints forming in the micropile.
- G. Pile grouting and bond zone drilling operations for each individual micropile shall be completed during the same working day to prevent bond zone deterioration or inflow of deleterious materials into the bond zone of the micropile.
- H. If grout loss or a drop in the grout level is observed after grouting and prior to the placement of core reinforcement, the grout will be allowed to cure for one day. The hole will then be re-drilled and re-grouted. This process will be repeated until no grout loss or drop in the grout level is observed after grouting and prior to the placement of core reinforcement.
- I. Provide hot weather protection to grout mix, installation equipment during placement, and fresh grout during curing in conformance to ACI 305, or as required by Owner's Representative/Engineer.
- J. Provide cold weather protection to grout mix and installation equipment during placement to prevent installation of frozen grout.
- K. Provide cold weather protection to all exposed surfaces of fresh grout during curing in conformance to ACI 306, or as required by Owner's Representative/Engineer.

- L. The Contractor shall be responsible for cleaning up and disposing of all construction related debris and spoils and disposing of them in a near site disposal area.
- M. The Contractor shall leave site at a uniformly sloping grade that precludes excessive ponding of water at the site.

3.04 OBSTRUCTIONS:

- A. Obstructions are defined as any object encountered below ground surface during drilled micropile installation that prevents advancement of the pile element to the design depth.
- B. The Contractor shall reference the boring logs, laboratory data, and available plans showing site conditions as provided in Section 00 31 32.
- C. If an obstruction is encountered, the Contractor shall document the following items, and submit them to the Owner's Representative/Engineer at the end of each work week.
 - 1. Date and time that the obstruction was encountered.
 - 2. Duration that the obstruction prevented Work progress.
 - 3. Depth or depth range of the obstruction.
 - 4. Date and time that the obstruction was passed, and production Work resumed.
 - 5. Nature of the obstruction, and how the obstruction prevented the Work progress.
 - 6. Measures implemented to overcome the obstruction.
 - 7. Cost impact of the obstruction on the Work (labor, equipment, materials).
- D. The Owner's Representative/Engineer will also document the above information when notified by the Contractor that obstructions are encountered.
- E. Where obstructions interfere with installing an element at the location shown on the plans and to the required depth, the Contractor shall propose methods and submit details to the Owner's Representative/Engineer for removal of or advancement through obstructions if encountered during the installation of the micropiles. No excavation for obstruction removal shall be conducted except in the presence of the Owner's Representative/Engineer. Pre-excavations shall be backfilled in accordance with Section 31 00 00 – Earthwork.
- F. If an obstruction is encountered that the installation rig cannot overcome, the Contractor shall move to another production location and continue the Work, while the obstruction is removed, or the Owner's Representative/Engineer selects an alternate element location to replace the obstructed location.
- G. Fill with grout any micropile abandoned because of obstructions encountered before reaching the anticipated depth at no additional cost to the Owner.

3.05 MICROPILE PENETRATION:

- A. Micropiles shall have a bond zone which starts below the top of the bonding stratum (excluding the casing plunge depth) and extends to at least the required minimum length to develop frictional capacity as determined by the design calculations and confirmed by static load testing.

3.06 REJECTED PILES:

- A. The Owner's Representative/Engineer will determine the acceptability of all micropiles placed and may reject those piles which do not conform to the Contract Documents.
- B. As required by the Owner's Representative/Engineer, for those micropiles which have been rejected, micropiles shall either be left in place or cut off and then install one or more new micropiles at locations designated by the Owner's Representative/Engineer to replace the rejected pile and maintain symmetry of the pile group or cluster at no additional cost to the Owner.

3.07 MICROPILE LOAD TEST PROGRAM:

- A. Perform verification testing of micropiles per the Contractor's approved pile load testing plan at the locations selected by Owner's Representative/Engineer. The Owner's Representative/Engineer shall be on-site to observe and document the load test.
- B. The load tests shall conform to the requirements of ASTM D1143 (vertical compression load testing) or ASTM D3689 (vertical tension load testing) except as modified herein. Test micropiles shall be installed in accordance with procedures required for production piles.
- C. The maximum verification test loads applied to the micropile shall not exceed 80 percent of the structural capacity of the micropile structural elements; including steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. Any required increase in strength of the verification test pile elements above the strength required for production piles shall be provided for in the Contractor's bid price.
- D. Testing equipment shall include dial gauges, dial gauge independent reference frame, jack and pressure gauge, electronic load cell (with readout device), strain gauges, and a reaction frame. The Contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves in accordance with the submittals section.
- E. The testing reaction frame shall be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Align the jack, bearing plates, and stressing anchorage such that unloading and repositioning of the equipment will not be required during the test. The reaction frame shall be monitored for movement during the load test by optical survey.
- F. Apply and measure the test load with a hydraulic jack and pressure gauge and load cell. The pressure gauge shall be graduated in 100 psi increments or less. The jack and pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. Jack ram travel shall be sufficient to allow the test to be done without resetting the equipment. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the verification test. The alignment load (AL) shall not be more than 5% of the maximum test load.
- G. Measure the pile top movement with at least three (3) dial gauges set 60 degrees apart

capable of measuring to 0.001-inch. The dial gauge shall have a travel sufficient to allow the test to be done without having to reset the gauge. Visually align the gauges to be parallel with the axis of the micropile and support the gauges independently from the jack, micropile, or reaction frame.

- H. Provide approved strain gauges in each verification load test pile. A minimum of three strain gauges shall be attached to the steel core in each test pile: 1 foot from the bottom of the micropile, at the mid-point between the bottom of the micropile and the bottom of the surface casing, and at the bottom of the surface casing. There must also be at least one stain gauge per each 10 feet of total bond length. Provide a strain gauge switching unit and a readout unit for reading the gauges during the load test.
- I. Additional testing due to failed verification tests shall be completed at no expense to the Owner. The Contractor shall reimburse Owner for additional costs incurred by the Owner’s Representative/Engineer including, but not limited to, additional field observation, submittal review, and redesign of foundations.
- J. Verification Load Testing
 - 1. The Contractor shall conduct a static verification pile load test up to 200% of the design bearing load on a sacrificial pile in advance of installing production micropiles. The verification test micropile shall be at a location approved by the Owner’s Representative/Engineer.
 - 2. The Contractor shall perform a minimum of two exploratory micropile drill probes at non-production pile locations distributed across the project site. The Owner’s Representative/Engineer will identify specific locations for the exploratory drill probes based on previous borings performed at the site and the foundation plan.
 - 3. Based upon the results of the exploratory micropile probes, the Owner’s Representative/Engineer will select the exploratory micropile probe to be completed as the verification test pile. The remaining exploratory micropile probe locations shall be backfilled with bentonite chips and/or cement grout.
 - 4. The Contractor shall assess the micropile performance and capacity and notify the Owner’s Representative/Engineer of modifications to the pile, if any. These modifications may include modifying the installation methods, increasing the bond length, or changing the micropile type.
 - 5. At the completion of verification testing, test micropile shall be removed down to an elevation specified by the Owner’s Representative/Engineer.
 - 6. The verification testing shall be loaded as indicated in the table below:

Verification Load Test Table

Step	Loading	Applied Load	Hold Time (min.)
1	Apply AL	0.05 DL	2.5
2	Cycle 1	0.15 DL	2.5
		0.30 DL	2.5
		0.45 DL	2.5
		AL	1.0
3	Cycle 2	0.15 DL	1.0

		0.45 DL	1.0
		0.60 DL	2.5
		0.75 DL	2.5
		0.90 DL	2.5
		1.00 DL	2.5
		AL	1.0
4	Cycle 3	0.15 DL	1.0
		1.00 DL	1.0
		1.15 DL	2.5
		1.30 DL	Creep Test - See Below
Hold the load for the Creep Test at least 10 minutes while recording movement at 1, 2, 3, 4, 5, 6, and 10-minute intervals. If the total movement measuring during the load hold exceeds the specified maximum value, the load should be extended for an additional 50 minutes (i.e., 1 hr. total hold time).			
5	Cycle 3 cont'd.	1.45 DL	2.5
		AL	1.0
6	Cycle 4	0.15 DL	1.0
		1.45 DL	1.0
		1.60 DL	1.0
		1.75 DL	2.5
		1.90 DL	2.5
		2.00 DL	10.0
		1.50 DL	5.0
		1.00 DL	5.0
		0.50 DL	5.0
		AL	5.0
7	Remove the load and compare results to acceptable criteria.		

Notes: Measurement of micropile movement shall be obtained at each increment. The load hold period shall start as soon as the test load is applied. The alignment load (AL) shall not exceed 5 percent of the DL load. Dial gages shall be reset to zero after the initial AL is applied.

7. Acceptance Criteria

1. The total vertical movement at the micropile head for the 1.0 DL load increment should not exceed 0.5-inch.
2. The total vertical movement at the end of the 1.3 DL load increment should not exceed 0.04-inch for the hold time between 1 and 10 minutes and should not exceed 0.08-inch between 6 and 60 minutes if held longer.
3. The failure load is defined as the load where the slope of the load versus micropile head deflection first exceeds 0.025-in./kip.

3.08 WASTE MANAGEMENT:

- A. Separate and dispose of waste in accordance with the Project's Waste Management Plan, if applicable. Site cleanup shall be performed to the satisfaction of the General Contractor.

END OF SECTION

SECTION 32 12 00

PAVING

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish all labor, materials and equipment and shall replace the pavements as indicated on the drawings and as herein specified.

1.02 RELATED WORK:

- A. Section 00 31 43 PERMITS
- B. Section 01 14 19.16, DUST CONTROL
- C. Section 31 00 00, EARTHWORK

1.03 SYSTEM DESCRIPTION:

A. GENERAL

The types of pavement systems to be utilized on this project are as follows:

TYPE 1. PARKING LOTS AND DRIVEWAYS

PAVEMENT SCHEDULE

B. TYPE 1. PARKING LOTS AND DRIVEWAYS

Proposed pavement for the Ledgeview Sewer Pump Station Upgrade shall include winter binder course pavement, 4-inches thick installed in multiple lifts.

1.04 REFERENCES

The following standards form a part of these specifications and indicate the minimum standards required:

American Society for Testing and Materials (ASTM)

ASTM D1557 Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 Pound Rammer and 18-Inch Drop

State of New Hampshire Department of Transportation (NHDOT) Standard Specifications for

	Road and Bridge Construction
NHDOT 304	Aggregate Base Course
NHDOT 306	Reclaimed Stabilized Base
NHDOT 401	Plant Mix Pavements - General
NHDOT 403	Hot Bituminous Pavement
NHDOT 411	Plant Mix Surface Treatment
NHDOT 417	Cold Planing of Bituminous Surfaces
NHDOT 632	Retroreflective Pavement Markings

Federal Specifications

SS-S-1401C	Sealants, Joint, Non-Jet-Fuel-Resistant, Hot Applied, for Portland Cement and Asphalt Concrete Pavement
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American Association of State Highway and Transportation Officials

AASHTO M 220	Standard Specifications for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
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1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Six sets of complete job mix formula shall be submitted to the Engineer at least two weeks before any of the work of this section is to begin.

PART 2 - PRODUCTS

2.01 GRAVEL SUBBASE:

- A. Gravel subbase shall consist of inert material that is hard durable stone and coarse sand, free from loam and clay, surface coatings and deleterious materials.
- B. Gradation requirements for gravel subbase shall be as specified in Section 31 00 00, EARTHWORK for Gravel Borrow.

2.02 HOT MIX ASPHALT (HMA) PAVEMENT:

- A. HMA pavements shall comply with Section 401 Plant Mix Pavements – General.
- B. HMA mixtures shall be within the aggregate size limits of base courses, binder courses and top courses, in accordance with Section 401 Plant Mix Pavements - General, Table

401-1 Design Control Points.

- C. The elastomeric joint seal shall conform to AASHTO M 220.
- D. The tack coat shall be an asphalt emulsion, RS-1, conforming to Section 702 Bituminous Materials.

PART 3 - EXECUTION

3.01 GENERAL:

Paving courses required for the project shall be as specified herein. Pavement thicknesses specified are measured in compacted inches. If a pavement course thickness exceeds 2-1/2 compacted inches, the course shall be installed in multiple lifts with each lift not exceeding 2-1/2 compacted inches in thickness.

3.02 GRAVEL SUBBASE:

- A. The gravel subbase to be placed under pavement shall consist of **12-inches** of gravel evenly spread and thoroughly compacted.
- B. The gravel shall be spread in layers not more than 4-inches thick, compacted measure. All layers shall be compacted to not less than 95 percent of the maximum dry density of the material as determined by ASTM D1557 Method C at optimum moisture content.

3.03 PAVEMENT PLACEMENT:

- A. Unless otherwise permitted by the Engineer for particular conditions, only machine methods of placing the pavement shall be used. The equipment for spreading and finishing shall be mechanical, self-powered pavers, capable of spreading and finishing the mixture true to line, grade, width and crown. The mixtures shall be placed and compacted only at such times as to permit proper inspection and checking by the Engineer.
- B. After the paving mixtures have been properly spread, initial and final compaction shall be obtained by the use of steel wheel rollers having a weight of not less than 8 tons. Intermediate compaction shall be done by a pneumatic-tired roller. The rollers shall provide an operating weight of not less than 2,000 pounds per wheel.
- C. Final rolling of the top course or surface treatment pavement shall be performed at a mix temperature and time sufficient to allow for final smoothing of the surface and thorough compaction.
- D. Immediately after placement of top course or surface treatment pavement, all joints between the existing and new top course or surface treatment pavements shall be sealed with hot poured rubberized asphalt sealant meeting the requirements of Federal Specification SS-S-1401.

- F. When required by the Engineer, the Contractor shall furnish and install additional paving to provide satisfactory transition. The transition installation will be considered incidental to the project.

3.04 PARKING LOTS AND DRIVEWAYS:

- A. Pavement shall consist of a 4-inch winter course on a 12-inch gravel sub-base. All thicknesses are compacted thicknesses.
- B. Adjacent concrete work, slate work, sidewalks, structures, etc., shall be protected from stain and damage during the entire operation. Damaged or stained areas shall be replaced or repaired to equal their original condition.
- C. All joints between binder and top course shall be staggered a minimum of 6-inches.
- D. After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened sufficiently to prevent distortion and loss of fines, and in no case in less than 6 hours.
- E. Smoothness of all areas of the finished surface shall not vary more than 1/4-inch when tested with a 10 foot straight-edge, applied both parallel to and at right angles to the centerline of the paved area. At building entrances, curbs, and other locations where an essentially flush transition is required, pavement elevation tolerance shall not exceed plus or minus 1/8-inch. Irregularities exceeding these amounts, or which retain water on the surface, shall be corrected by removing the defective work and replacing or repairing it to the satisfaction of the Engineer.
- F. The surface area to be seal coated, as shown on the drawings, shall be swept and air cleaned. The first coat shall be applied with eight (8) pounds of #30 silica sand blended with each gallon of emulsion applied at a rate of 0.15 gallons per square yard. The second coat shall be a straight sealer applied at the rate of 0.1 gallons per square yard.

END OF SECTION

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SECTION 32 91 19

LOAMING AND SEEDING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers all labor, materials, and equipment necessary to do all loaming, seeding and related work as indicated on the drawings and as herein specified. All lawns disturbed by the Contractor's operations shall be repaired as herein specified.

1.02 QUALITY ASSURANCE:

- A. For a particular source of loam, the Engineer may require the Contractor to send approximately 10 pounds of loam to an approved testing laboratory and have the following tests conducted:
 - 1. Organic concentration
 - 2. pH
 - 3. Nitrogen concentration
 - 4. Phosphorous concentration
 - 5. Potash concentration
- B. These tests shall be at the Contractor's expense. Test results, with soil conditioning and fertilizing recommendations, shall be forwarded to the Engineer.

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Information detailing the seed mixes, fertilizers, mulch material, slope protection material (if required) and origin of loam.
- B. Test results.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. LOAM:

- 1. Loam shall be a natural, fertile, friable soil, typical of productive soils in the vicinity, obtained from naturally well-drained areas, neither excessively acid nor alkaline, and containing no substances harmful to grass growth. Loam shall not be delivered to the site in frozen or muddy condition and shall be reasonably free of stumps, roots,

heavy or stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other litter.

- 2. The loam shall contain not less than 4 percent or more than 20 percent organic matter as determined by the loss of weight by ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F.

B. LIME:

Lime shall be standard commercial ground limestone containing at least 50 percent total oxides (calcium oxide and magnesium oxide), and 50 percent of the material must pass through a No. 100 mesh sieve with 98 percent passing a No. 2 mesh sieve.

C. FERTILIZER:

Fertilizer shall be commercial fertilizer, 10-10-10 fertilizer mixture containing at least 40 percent of organic nitrogen. It shall be delivered to the site in the original sealed containers, each showing the manufacturer's guaranteed analysis. Fertilizer shall be stored so that when used it will be dry and free flowing. No fertilizer shall be used which has not been marketed in accordance with State and Federal Laws, relating to fertilizers.

D. MULCH:

- 1. Materials to be used in mulching shall conform to the following requirements:
- 2. Straw Mulch - Straw Mulch shall consist of stalks or stems of grain after threshing.
- 3. Wood Fiber Mulch - Wood Fiber Mulch shall consist of wood fiber produced from clean, whole uncooked wood, formed into resilient bundles having a high degree of internal friction and shall be dry when delivered to the project.

E. SEED:

- 1. Seed shall be of an approved mixture, the previous year's crop, clean, high in germinating value, a perennial variety, and low in weed seed. Seed shall be obtained from a reliable seed company and shall be accompanied by certificates relative to mixture purity and germinating value.
- 2. Grass seed for lawn areas shall conform to the following requirements:

	Proportion by Weight	Germination Purity	Purity Minimum
Chewing's Fescue	30%	70%	97%
Kentucky 31 Fescue	30%	90%	98%
Kentucky Blue Grass	20%	80%	85%
Domestic Rye Grass	20%	90%	98%

Grass seed for cross-country areas, slopes and other areas not normally mowed shall conform to the following requirements:

	Proportion by Weight	Germination Minimum	Purity Minimum
Creeping Red Fescue	50%	85%	95%
Kentucky 31	30%	85%	95%
Domestic Rye	10%	90%	98%
Red Top	5%	85%	92%
Ladino Clover	5%	85%	96%

F. TEMPORARY COVER CROP:

1. Temporary cover crop shall conform to the following requirements:

	% Weight	Germination Minimum
Winter Rye	80 min.	85%
Red Fescue (creeping)	4 min.	80%
Perennial Rye Grass	3 min.	90%
Red Clover	3 min.	90%
Other Crop Grass	0.5 max.	
Noxious Weed Seed	0.5 max.	
Inert Matter	1.0 max.	

G. SLOPE EROSION PROTECTION:

1. Erosion control blanket shall be 100% degradable plastic mesh with 100% degradable straw or straw/coconut fill. Fill shall be held together by degradable fastening. Weight shall be 0.50 lb./sq. yd. Erosion control blankets shall be applied parallel to direction of water flow. The erosion control blankets shall be by North American Green, Evansville, IN or approved equal. For slopes 2:1 or greater, Model SC150 shall be used. For slopes less than 2:1, Model S150 shall be used.
2. Six inch wire staples shall be placed according to manufacturer’s recommendations to anchor the mesh material. Staples shall be designed to decompose.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. After approval of rough grading, loam shall be placed on areas affected by the Contractor's operations. Loam shall be at least 6-inches compacted thickness.

- B. Lime shall be applied to bring the pH to 6.5 or, without a soil test, at the rate of 2-3 tons of lime per acre.
- C. Fertilizer shall be applied according to the soil test, or without a soil test, at the rate of 1000 pounds per acre.
- D. Loam shall be worked a minimum of 3-inches deep, thoroughly incorporating the lime and fertilizer into the soil. The loam shall then be raked until the surface is finely pulverized and smooth and compacted with rollers, weighing not over 100 pounds per linear foot of tread, to an even surface conforming to the prescribed lines and grades. Minimum depth shall be 6-inches after completion.

3.02 SEEDING:

- A. Seeding shall be done when weather conditions are approved as suitable, in the periods between April 1 and May 30 or August 15 to October 1, unless otherwise approved.
- B. If there is a delay in seeding, during which weeds grow or soil is washed out, the Contractor shall remove the weeds or replace the soil before sowing the seed, without additional compensation. Immediately before seeding is begun, the soil shall be lightly raked.
- C. Seed shall be sown at the approved rate, on a calm day by machine.
- D. One half the seed shall be sown in one direction and the other half at right angles. Seed shall be raked lightly into the soil to a depth of 1/4-inch and rolled with a roller weighing not more than 100 pounds per linear foot of tread.
- E. The surface shall be kept moist by a fine spray until the grass shows uniform germination over the entire area. Wherever poor germination occurs in areas larger than 3 sq. ft., the Contractor shall reseed, roll, and water as necessary to obtain proper germination.
- F. The Contractor shall water, weed, cut and otherwise maintain and protect seeded areas as necessary to produce a dense, healthy growth of perennial lawn grass.
- G. If there is insufficient time in the planting season to complete the fertilizing and seeding, permanent seeding may be left until the following planting season, at the option of the Contractor or as required by the Engineer. In that event, a temporary cover crop shall be sown. This cover crop shall be cut and watered as necessary until the beginning of the following planting season, at which time it shall be plowed or harrowed into the soil, the area shall be fertilized and the permanent seed crop shall be sown as specified.

3.03 PLACING MULCH:

- A. Straw Mulch shall be loosely spread to a uniform depth over all areas designated on the plans, at the rate of 4-1/2 tons per acre, or as otherwise required.

- B. Straw Mulch may be applied by mechanical apparatus, if in the judgment of the Engineer the apparatus spreads the mulch uniformly and forms a suitable mat to control slope erosion. The apparatus shall be capable of spreading at least 80 percent of the hay or straw in lengths of 6-inches or more, otherwise it shall be spread by hand without additional compensation.
- C. Wood Fiber Mulch shall be uniformly spread over certain selected seeded areas at the minimum rate of 1,400 pounds per acre unless otherwise required. It shall be placed by spraying from an approved spraying machine having pressure sufficient to cover the entire area in one operation.

3.04 SEEDING AND MULCHING BY SPRAY MACHINE:

- A. The application of lime, fertilizer, grass seed and mulch may be accomplished in one operation by the use of an approved spraying machine. The materials shall be mixed with water in the machine and kept in an agitated state in order that the materials may be uniformly suspended in the water. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of lime, fertilizer, grass seed and mulch shall be equal to the specified quantities.
- B. A certified statement shall be furnished, prior to start of work, to the Engineer by the Contractor as to the number of pounds of limestone, fertilizer, grass seed and mulch per 100 gallons of water.
- C. This statement should also specify the number of square yards of seeding that can be covered with the solution specified above. If the results of the spray operation are unsatisfactory, the Contractor will be required to abandon this method and to apply the lime, fertilizer, grass seed and mulch by other methods.

3.05 INSPECTION AND ACCEPTANCE:

At the beginning of the planting season following that in which the permanent grass crop is sown, the seeded areas will be inspected. Any section not showing dense, vigorous growth at that time shall be promptly reseeded by the Contractor at his own expense. The seeded areas shall be watered, weeded, cut and otherwise maintained by the Contractor until the end of that planting season, when they will be accepted if the sections show dense, vigorous growth.

END OF SECTION

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SECTION 33 05 13.16

BUILDING MANHOLE INVERTS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers all manholes complete, including, but not limited to, bases, mortar, and inverts.

1.02 RELATED WORK:

- A. Section 01 12 16, SCOPE AND SEQUENCE OF WORK
- B. Section 01 14 19.22, HANDLING EXISTING FLOWS
- C. Section 01 33 19, DOCUMENTATION
- D. Section 01 33 23, SUBMITTALS

1.03 SYSTEM DESCRIPTION:

- A. Invert channel shall be formed of brick and mortar upon the base.

1.04 REFERENCES:

- A. The following standards form a part of this specification as referenced:

ASTM International (ASTM)

ASTM C32	Sewer and Manhole Brick
ASTM C144	Aggregate for Masonry Mortar
ASTM C207	Hydrated Lime for Masonry Purposes
ASTM C923	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
ASTM C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer's literature of the materials of this section.
- B. Tests reports as required by the Engineer.

PART 2 – INVERT MATERIALS

2.01 The invert shall be formed of brick and mortar, as specified in this specification section.

2.02 BRICK MATERIALS:

- A. Brick shall be sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. Bricks shall comply with ASTM C32, for Grade SS, hard brick, except that the mean of five tests for absorption shall not exceed 8 percent by weight.
- B. Rejected brick shall be immediately removed from the work and brick satisfactory to the Engineer substituted.
- C. Mortar shall be composed of portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as required and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for Grade SS Brick shall be mixed in the volume proportions of 1:1/2:4-1/2; portland cement to hydrated lime to sand.
- D. Cement shall be Type II portland cement as specified for concrete masonry.
- E. Hydrated lime shall be Type S conforming to ASTM C207.
- F. The sand shall comply with ASTM C144 specifications for "Fine Aggregate," except that all of the sand shall pass a No. 8 sieve.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. INVERT BRICK WORK:

1. All debris shall be removed from the bottom of the manhole before the invert is constructed.
2. Bricks shall be moistened by suitable means, as required, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
3. Each brick shall be laid as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as required.

4. The brick inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved, and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipe.

3.02 CLEANING:

All manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

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SECTION 33 05 26.13

TRACER TAPE

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers the furnishing, handling and installation of tracer tape, as called for on the drawings.

1.02 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer's literature on the materials, colors and printing specified herein, shall be submitted to the Engineer for review.
- B. Tape samples shall also be submitted to the Engineer for review.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

Tracer tape shall be by Reef Industries, Houston, TX; Empire Level, Mukwonago, WI; Pro-Line Safety Products Co., W. Chicago, IL; or approved equal.

2.02 TRACER TAPE:

- A. Tracer tape shall be at least 3-inches wide.
- B. Tracer tape for non-ferrous pipe or conduit shall be constructed of a metallic core bonded to plastic layers. The metallic tracer tape shall be a minimum 5-mil thick and must be locatable at a depth of 18-inches with ordinary pipe locaters.
- C. Tracer tape for ferrous pipe or conduit shall consist of multiple bonded plastic layers. The non-metallic tracer tape shall elongate at least 500% before breaking.
- D. The tape shall bear the wording: "BURIED DRAIN LINE BELOW" (with "DRAIN" replaced by "WATER", "SEWER", "ELECTRICAL", "GAS", "TELEPHONE", or "CHEMICAL" as appropriate), continuously repeated every 30-inches to identify the pipe.
- E. Tape colors shall be as follows, as recommended by the American Public Works Association (APWA):

Electric	Red
Gas & Oil	Yellow
Communications	Orange
Water	Blue

Sewer & Drain
Chemical

Green
Red (not APWA)

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Tracer tape shall be installed directly above the pipe or conduit it is to identify, approximately 12-inches below the proposed ground surface.
- B. The Contractor shall follow the manufacturer's recommendations for installation of the tape, as approved by the Engineer.

END OF SECTION

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SECTION 33 11 13.31

POLYVINYL CHLORIDE PIPE
AND FITTINGS (SCHEDULE 80)

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers polyvinyl chloride (PVC) Schedule 80 pipe and fittings as shown on the drawings and as specified herein.

1.02 RELATED WORK:

- A. Section 31 50 00, SUPPORT OF EXCAVATION
- B. Section 31 00 00, EARTHWORK
- C. Section 33 05 26.13, TRACER TAPE

1.03 QUALITY ASSURANCE:

- A. All pipe and fittings shall be inspected and tested at the factory as required by the standard specifications to which the material is manufactured. The Contractor shall furnish in duplicate to the Engineer sworn certificates of such tests.
- B. In addition, the Owner reserves the right to have any or all pipe, fittings, and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

1.04 REFERENCES:

- A. The following standards form a part of this work as referenced:

American Society for Testing and Materials (ASTM)

ASTM	D1784	Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
ASTM	D1785	Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM	D2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe

ASTM	D2464	Specification for Threaded Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
ASTM	D2467	Specification for Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
ASTM	D2564	Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
ASTM	D2855	Recommended Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Plastic Pipe and Fittings

American Water Works Association (AWWA)

AWWA	C651	Disinfecting Water Mains
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1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Shop drawings shall consist of manufacturer's scale drawings, cut, or catalogs including descriptive literature and complete characteristics and specifications, and code requirements. Shop drawings shall be submitted for the PVC pipe, type of joints, fittings, and couplings in accordance with specifications.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS:

- A. Unless specifically designated otherwise, PVC pipe and fittings shall be Schedule 80 with solvent weld joints as specified herein.
- B. PVC Schedule 80 pipe shall conform to ASTM D1785.
- C. PVC Schedule 80 socket fittings shall conform to ASTM D2467 and PVC Schedule 80 threaded fittings to ASTM D2464.
- D. Rigid PVC used in the extrusion of the pipe and fittings shall be Type 1, Grade 1 compound as stated in ASTM D1784 with a cell classification of 12454B.
- E. Both pipe and fittings shall be the product of one manufacturer.
- F. Solvent cements shall conform to ASTM D2564.

PART 3 - EXECUTION

3.01 HANDLING AND CUTTING PIPE:

- A. Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, scratching or marring surfaces, and abrasion of the pipe coating.
- B. Any fittings showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work site.
- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used will be perfectly sound. The cut shall be made in the sound barrel at a point at least 12-inches from the visible limits of the crack.
- D. Except as otherwise approved, all cutting shall be done with a machine suitable for cutting PVC pipes.

3.02 INSTALLING PIPE AND FITTINGS:

- A. Unless specifically otherwise required by the Engineer, all piping shall have not less than 5-feet of cover.
- B. Pipes and fittings shall be subjected to a careful inspection just before being laid or installed.
- C. No defective pipe or fittings shall be laid or placed in the piping, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.
- D. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the complete work.
- E. Pipe and fittings shall be laid accurately to the lines and grades indicated on the drawings or as required. Care shall be taken to ensure good alignment both horizontally and vertically.
- F. In buried pipelines, each pipe shall have firm bearing along its entire length.
- G. The deflection of alignment at a joint shall not exceed the appropriate permissible deflection as recommended by the manufacturer.
- H. Pipe shall be installed underground in a manner that will ensure that external loads will not subsequently cause a decrease of more than 5 percent in the vertical cross-section dimension (deflection). When installing the pipes, they shall be rotated 180° in order

that the upper quadrant of the pipe which was exposed to direct sunlight will not be backfilled upon.

- I. Except as specifically designated otherwise, installation shall be in accordance with ASTM D2321.
- J. At all times when pipe laying is not actually in progress, the open ends of pipe shall be closed by temporary water-tight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.

3.03 JOINTING OF PIPE:

- A. Jointing of pipe shall conform to ASTM D2855.
- B. Except where threaded fittings are required to adapt to metallic pipe, all fittings and pipe shall be solvent welded.
- C. Cementing operations shall not be attempted where the temperature of the pipe, fittings or ambient exceed 100°F. Cementing operations should be done out of direct sunlight.
- D. The following procedures shall be followed:
 - 1. Inspect fitting sockets and pipe ends to make sure there is no chipping, gouging or scratching.
 - 2. Clean pipe ends and fitting sockets carefully, using clean cotton wiping rags.
 - 3. Try fitting sockets on pipe to make sure the pipe will penetrate at least one third of socket depth.
 - 4. Cut pipe to length required. Pipe must be cut at right angle to linear section, deburred on the I.D. and deburred and slightly beveled on the O.D.
 - 5. Apply a coat of primer to fitting socket using a scrubbing motion to ensure penetration. Repeated applications may be necessary.
 - 6. Apply a liberal coating of primer to the end of the pipe, using a scrubbing motion to ensure penetration. Extend this coating slightly beyond fitting socket depth. Be sure the entire surface is well softened.
 - 7. Apply a second coat of primer to fitting socket and without delay apply a coat of cement to pipe end using a scrubbing motion to achieve an even coating.
 - 8. Without delay, apply a uniform, light coating of cement to fitting socket making sure that cement does not penetrate fitting portion of socket.

9. Without delay, apply a second coating of cement to pipe end and immediately insert pipe in fitting. Turn the pipe or fitting 1/4 turn during assembly to distribute the cement evenly, but not after the pipe is bottomed in the socket. Remove all excess cement from around pipe and fitting with clean dry rag. Assembly should be completed within 20 seconds after the last application of cement. Do not hammer or pound fittings or pipe during the assembly process. Socket and pipe surfaces must be soft and wet at time of assembly.
10. Hold socket and pipe in fully bottomed position until cement "sets up." Hold tightly for 30 seconds on sizes up to 4-inches.
11. Assemblies should not be handled excessively until set- up. Allow the following times:

30 minutes	at 60° to 100°F
1 hour	at 40° to 60°F
2 hours	at 20° to 40°F
4 hours	at 0° to 20°F

END OF SECTION

SECTION 33 11 13.43

INSULATION FOR PIPELINES

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the furnishing of all material, accessories, labor, and equipment necessary to insulate the pipelines where shown on the drawings and where so required by the Engineer.

1.02 RELATED WORK:

- A. Section 31 00 00, EARTHWORK
- B. Section 33 11 13.13, DUCTILE IRON PIPE AND FITTINGS

1.03 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM C552 Specification for Cellular Glass Block and Pipe Thermal Insulation

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer's literature of the materials of this section and installation instructions for the products being provided for the project.
- B. A sample of the insulation.

PART 2 - PRODUCTS

2.01 INSULATION:

- A. Insulation shall be cellular glass type. The insulation shall be a cellular glass product that is made specifically for thermal insulation of piping and is compatible with the piping material. Insulation shall be a minimum of 2-inches thick, unless otherwise shown on the drawings.
- B. Insulation shall be composed of all glass sealed cells having no binders or fillers. The completed product shall be rigid and impermeable, with an ultimate compressive

strength of at least 100 psi. The thermal conductivity of the cellular glass shall be no higher than 0.40 BTU/(hr)(sq. ft.)(EF/in).

- C. The cellular glass insulation shall comply with all requirements of ASTM C552. The cellular glass shall be fabricated in half sections whenever possible.
- D. Tees, valves, and bends shall be covered with form fitting factory made sections.
- E. The insulation shall be "Foamglass" with jacketing as manufactured by Pittsburgh Corning Corporation, Pittsburgh, PA, or an approved equal.
- F. The Foamglass and jacketing shall be installed per the manufacturer instructions included in the approved shop drawings.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Cellular glass shall not be applied to the piping until the piping has been wiped clean and supported so that there is adequate space to apply the full thickness of insulation and the covering completely around the pipe. The Contractor must obtain the Engineer's approval before the installation begins.
- B. Cellular glass insulation and jacketing shall be applied in accordance with the manufacturers installation procedures included in the approved shop drawings.
- C. There shall be at least three 0.50-inch wide stainless steel bands secured around each joint and these bands shall be placed not over 9 inches on center on straight sections of pipe.
- D. Tees, valves, and bends shall be covered with form fitting factory made sections.
- E. All testing of the piping system, such as hydrostatic, x-ray or other such testing, shall be accomplished prior to application of insulation.

END OF SECTION

SECTION 33 31 13.16

POLYVINYL CHLORIDE GRAVITY PIPE AND FITTINGS
(SDR-35)

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers the furnishing and installation of Polyvinyl Chloride (PVC) pipe and fittings, as indicated on the drawings and as specified herein.

1.02 RELATED WORK:

- A. Section 31 00 00, EARTHWORK
- B. Section 31 50 00, SUPPORT OF EXCAVATION
- C. Section 33 05 26.13, TRACER TAPE
- D. Section 33 31 13.37, VALVES AND APPURTENANCES FOR WASTEWATER WORK
- E. Section 33 39 13, PRECAST MANHOLES AND CATCH BASINS

1.03 REFERENCES:

- A. The following standards form a part of these specifications as referenced:

ASTM International (ASTM)

ASTM	D2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM	D3034	Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM	D3212	Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM	F679	Specification for Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings (18" - 27")

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23
SUBMITTALS, SUBMIT THE FOLLOWING:

Manufacturer's literature of the materials of this section.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. PVC nonpressure sewer pipe 4-inches through 15-inches diameter shall conform to ASTM D3034, 18-inches through 27-inches diameter to ASTM F679, all with SDR of 35 unless noted, and shall meet the specific requirements and exceptions to the aforementioned specifications that follow.
- B. PVC nonpressure sewer pipe shall be furnished in standard lengths.
- C. One pipe bell consisting of an integral wall section with a solid cross section rubber ring, factory assembled, shall be furnished with each standard, random and short length of pipe. Rubber rings shall be provided to the requirements of ASTM D3212.
- D. The rubber ring shall be retained within the bell of the pipe by a precision formed groove or recess designed to resist fishmouthing or creeping during assembly of joints.
- E. Spigot pipe ends shall be supplied with bevels from the manufacturer to ensure proper insertion. Each spigot end shall have an "assembly stripe" imprinted thereon to which the bell end of the mated pipe will extend upon proper jointing of the two pipes.
- F. PVC fittings shall be provided with bell and/or spigot configurations with rubber gasketed joints compatible with that of the pipe. Bend fittings with spigot ends shorter than the pipe recess bells will not be allowed. The shorter spigot end would not allow proper seating of the spigot in the mating bell and would permit undesired contact between the mating bell and the outside of the fitting bell.
- G. All pipe delivered to the job site shall be accompanied by independent testing laboratory reports certifying that the pipe and fittings conform to the above-mentioned specifications. In addition, the pipe shall be subject to thorough inspection and tests, the right being reserved for the Engineer to apply such of the tests specified as it may from time to time deem necessary.
- H. All cutting of pipe shall be done with a machine suitable for cutting PVC pipe. Cut ends shall be beveled when recommended by the pipe manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Except as modified herein, installation of the PVC pipe shall be in accordance with ASTM D2321.
- B. Each pipe length shall be inspected before being laid to verify that it is not cracked. Pipe shall be laid to conform to the lines and grades indicated on the drawings or given by the Engineer. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.

- C. The pipe shall be supported by compacted crushed stone. Crushed stone shall be as specified under Section 31 00 00, EARTHWORK.
- D. The pipe shall not be driven down to grade by striking it with a shovel handle, timber, rammer, or other unyielding object. When each pipe has been properly bedded, enough of the backfill material shall be placed and compacted between the pipe and the sides of the trench to hold the pipe in correct alignment.
- E. Before a joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that inverts are matched and conform to the required line and grade.
- F. For pipe placed on crushed stone, immediately after the joint is made, the jointing area shall be filled with suitable materials so placed and compacted that the ends of either pipe will not settle under backfill load.
- G. No pipe or fitting shall be permanently supported on saddles, blocking, or stones.
- H. Branches and fittings shall be laid by the Contractor as indicated on the drawings, and/or as required by the Engineer. Open ends of pipe and branches shall be closed with PVC caps secured in place with premolded gasket joints or as required by the Engineer.
- I. All pipe joints shall be made as nearly watertight as practicable. There shall be no visible leakage at the joints and there shall be no sand, silt, clay, or soil of any description entering the pipeline at the joints. Where there is evidence of water or soil entering the pipeline, connecting pipes, or structures, the defects shall be repaired to the satisfaction of the Engineer.
- J. The Contractor shall build a tight bulkhead in the pipeline where new work enters an existing sewer. This bulkhead shall remain in place until the Engineer authorizes its removal.
- K. Care shall be taken to prevent earth, water, and other materials from entering the pipe, and when pipe laying operations are suspended, the Contractor shall maintain a suitable stopper in the end of the pipe and also at openings for manholes.
- L. As soon as possible after the pipe and manholes are completed on any street, the Contractor shall flush out the new pipeline using a rubber ball ahead of the water, and none of the flushing water or debris shall be permitted to enter any existing sewer.

3.02 QUALITY CONTROL

A. LEAKAGE TESTING:

1. On completion of a section of sewer, including building connections installed to the property line, the Contractor shall install suitable bulkheads as required, dewater and test the sewer for leakage.

2. Unless otherwise approved, the section shall be tested using low pressure air test procedures. If circumstances permit, the Engineer may allow testing by infiltration or exfiltration in lieu of air testing.
3. The air test procedures shall conform to the Uni-Bell Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe, UNI-B-6. The starting air pressure for the test shall be 4 psig (greater than the average groundwater back pressure of any groundwater above the pipe, but not greater than 9.0 psig). The minimum duration permitted for the prescribed low pressure air exfiltration pressure drop between two consecutive manholes shall not be less than provided in Table I of UNI-B-6. The table is reproduced on the following pages.
4. Using the air pressure test, if there has been no leakage (zero psig drop) after one hour of testing, the section undergoing test shall have passed.
5. If either infiltration or exfiltration testing is permitted by the Engineer, the test shall be conducted for at least 24 hours. The amount of infiltration or exfiltration shall not exceed 100 gallons per inch-diameter per mile of sewer per 24 hours.
6. The infiltration test measures leakage into a section of sewer and may be used only where the groundwater level is one foot or more above the crown of the section of sewer pipe at its upper end and at least one foot above the top of building connections and chimneys. For making the infiltration tests, underdrains, if used, shall be plugged and other groundwater drainage shall be stopped to permit the groundwater to return to its normal level insofar as practicable. Allowances shall be made for water that may enter the sewer through pipe connections and inlets during the infiltration test.
7. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the exfiltration test may be used. The sewers shall be subjected to an internal pressure by plugging the pipe at the lower end and then filling the pipelines and manholes with clean water to a height of 2 feet above the highest point in the system to be tested, including main pipeline, service connections and chimneys. When slopes between manholes are steep, the Contractor shall insure that this test can be accomplished without danger of forcing stoppers from wye or tee branches.
8. The rate of exfiltration from the sewers shall be determined by measuring the amount of water required to maintain the water level at the elevation established at the beginning of the test.
9. The Contractor shall construct such weirs or other means of measurements as may be required, shall furnish water and shall do all necessary pumping to enable the test to be properly made.
10. The Contractor shall be responsible for the satisfactory watertightness of the entire section of sewer. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing leaks and retesting as the Engineer may require without additional compensation. A plan of the method of repairing any leaks that are found shall be submitted to the Engineer for review.

B. PIPE DEFLECTION MEASUREMENT:

1. In accordance with ASTM D3034, no less than 30 days after completion of the PVC sewer pipe installation, the Contractor shall test the pipeline for deflection using a "go/no-go" deflection mandrel having a minimum of nine evenly spaced arms or prongs. The "go/no-go" gauge shall be hand pulled through all sections of the pipeline by the Contractor. The Contractor shall submit drawings of the "go/no-go" gauge to the Engineer for approval prior to testing. Complete dimensions of the gauge for each diameter of pipe to be tested shall be in accordance with ASTM D3034.
2. Any section of pipe found to exceed 7.5 percent deflection shall be deemed a failed pipe and shall be excavated and replaced by the Contractor at its own expense.

TABLE I

SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

Pipe Diameter (in)	Minimum Time (min:sec)	Length for Min. Time (ft)	Length for Longer Length (sec)	Specification time for length (L) shown (min:sec)								
				<u>100 ft</u>	<u>150 ft</u>	<u>200 ft</u>	<u>250 ft</u>	<u>300 ft</u>	<u>350 ft</u>	<u>400 ft</u>	<u>450 ft</u>	
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	26:26	25:38	28:51	
21	9:55	114	5.235 L	9:55	13	17:27	21:49	26:11	30:32	34:54	39:16	
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	46:54	
30	14:10	80	10:683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	
33	15:35	72	12:926 L	21:33	32:19	43:56	53:25	64:28	75:24	86:10	96:57	
36	17:00	66	15:384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	

END OF SECTION

SECTION 33 31 13.19

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the furnishing, handling, hauling, laying, jointing, and testing of ductile iron pipe used for gravity sewer and force main construction, including fittings and appurtenant work as indicated on the drawings and as specified.

1.02 RELATED WORK:

- A. Section 31 50 00, SUPPORT OF EXCAVATION
- B. Section 31 00 00, EARTHWORK
- C. Section 33 31 13.37, VALVES AND APPURTENANCES FOR WASTEWATER WORK

1.03 QUALITY ASSURANCE

- A. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. The Contractor shall furnish in duplicate to the Engineer sworn certificates of such tests.
- B. In addition, the Owner reserves the right to have any or all pipe, fittings and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

1.04 REFERENCES:

- A. The following standards form a part of these specifications as referenced:

American Water Works Association

AWWA	C104	Cement-Mortar Lining for Ductile- Iron Pipe and Fittings for Water Flexible Elastomeric Seals
AWWA	C110	Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for Water and Other Liquids
AWWA	C111	Rubber Gasket Joints for Ductile- Iron and Gray-Iron Pressure Pipe and Fittings
AWWA	C150	Thickness Design of Ductile-Iron Pipe
AWWA	C116	Protective Fusion Bonded Epoxy Coatings for the Interior and

Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings

AWWA C151 Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids

AWWA C153 Ductile-Iron Compact Fittings, 3 inches through 64 inches for Water Service.

AWWA C600 Installation of Ductile-Iron Water Mains

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01330 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer's literature of the materials of this section.
- B. Shop drawings consisting of manufacturer's scale drawings, cuts or catalogs including descriptive literature and complete characteristics and specifications, and code requirements. Shop drawings shall be submitted for the ductile iron pipe, type of joint, fittings, couplings, filling rings, and lining and coating in accordance with specifications.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. The Contractor shall use push-on joint type ductile iron pipe unless otherwise indicated on the plans or specified herein.
- B. All ductile iron pipe shall be designed in accordance with AWWA C150 and shall be manufactured in accordance with AWWA C151.
- C. Unless otherwise indicated or specified, ductile iron pipe shall be Thickness Class 52.
- D. All pipe delivered to the job site shall be accompanied by independent testing laboratory reports certifying that the pipe and fittings conform to the above-mentioned specifications. In addition, the pipe shall be subject to thorough inspection and tests, the right being reserved for the Engineer to apply such of the tests specified, as he may from time to time deem necessary.
- E. All cutting of pipe shall be done with a machine suitable for cutting DI pipe. Cut ends shall be beveled when recommended by the pipe manufacturer.

2.02 FITTINGS:

- A. Fittings shall conform to the requirements of AWWA C110 or C153 as appropriate and shall be of a pressure classification at least equal to that of the pipe with which they are used.
- B. The Contractor shall use ductile iron fittings. Cast-iron, Class 250 fittings may be substituted, upon approval of the Engineer, for ductile iron fittings.
- C. Unless otherwise indicated, fittings shall have all bell mechanical joint ends.

2.03 GASKETS, GLANDS, NUTS AND BOLTS:

- A. Gaskets, glands, nuts, bolts and accessories shall conform to AWWA C111 or C153 as appropriate.
- B. Gaskets shall be of plain tipped rubber, suitable for exposure to the liquid within the pipe.
- C. Glands shall be ductile or cast iron.
- D. Bolts and nuts shall be high strength alloy.

2.04 LINING AND COATING:

- A. The inside of pipe and fittings shall be given a cement lining and asphaltic seal coat in accordance with AWWA C104. The thickness of the lining shall be double that specified in AWWA C104.
- B. The outside of pipe and fittings shall be coated with the standard asphaltic coating specified under the appropriate AWWA Standard Specification for pipe and fittings.
- C. Machined surfaces shall be cleaned and coated with a suitable rust preventative coating at the shop immediately after being machined.

2.05 FLEXIBLE COUPLINGS:

- A. All sleeve-type couplings and accessories shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.
- B. Couplings shall be cast or ductile iron and shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.
- C. Couplings for buried pipe shall be Dresser 153; Smith-Blair Type 441 or 443; Romac Style 501; Ford Style FC1 or FC2; or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION BEFORE INSTALLATION:

Pipes and fittings shall be subjected to a careful inspection just before being laid or installed.

3.02 HANDLING AND CUTTING:

- A. Any pipe or fitting which has a damaged lining, scratched or marred machine surface and/or abrasion of the pipe coating or lining shall be rejected and removed from the job-site.
- B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used will be perfectly sound. The cut shall be made in the sound barrel at a point at least 12-inches from the visible limits of the crack.
- D. Except as otherwise approved, all cutting shall be done with a machine suitable for cutting ductile iron pipe. Hydraulic squeeze cutters are not acceptable for cutting ductile iron pipe. Travel type cutters or rotary type abrasive saws may be used. All cut ends shall be examined for possible cracks caused by cutting.
- E. Lined and coated pipe and fittings shall be assembled and installed with approved packing or gaskets of the type recommended by the pipe manufacturer for the particular lining used.

3.03 INSTALLATION:

- A. Each pipe length shall be inspected before being laid to verify that it is not cracked. Pipe shall be laid to conform to the lines and grades indicated on the drawings or given by the Engineer. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.
- B. The pipe shall be supported by compacted crushed stone. Crushed stone shall be as specified under Section 31 00 00, EARTHWORK.
- C. The pipe shall not be driven down to grade by striking it with a shovel handle, timber, rammer, or other unyielding object. When each pipe has been properly bedded, enough of the backfill material shall be placed and compacted between the pipe and the sides of the trench to hold the pipe in correct alignment.
- D. Before a joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that inverts are matched and conform to the required line and grade.
- E. For pipe placed on crushed stone, immediately after the joint is made, the jointing area shall be filled with suitable materials so placed and compacted that the ends of either pipe will not settle under backfill load.
- F. No pipe or fitting shall be permanently supported on saddles, blocking, or stones.
- G. Branches and fittings shall be laid by the Contractor as indicated on the drawings, and/or as required by the Engineer. Open ends of pipe and branches shall be closed with DI caps secured in place with premolded gasket joints or as required by the Engineer.
- H. All pipe joints shall be made as nearly watertight as practicable. There shall be no visible leakage at the joints and there shall be no sand, silt, clay, or soil of any description entering the pipeline at the joints. Where there is evidence of water or soil entering the pipeline, connecting pipes, or structures, the defects shall be repaired to the satisfaction of the Engineer.

- I. The Contractor shall build a tight bulkhead in the pipeline where new work enters an existing sewer. This bulkhead shall remain in place until its removal is authorized by the Engineer.
- J. Care shall be taken to prevent earth, water, and other materials from entering the pipe, and when pipe-laying operations are suspended, the Contractor shall maintain a suitable stopper in the end of the pipe and at openings for manholes.
- K. As soon as possible after the pipe and manholes are completed on any street, the Contractor shall flush out the new pipeline using a rubber ball ahead of the water, and none of the flushing water or debris shall be permitted to enter any existing sewer.

3.04 PUSH ON JOINTS:

- A. Joining of push-on joint pipe shall conform to AWWA C600.
- B. If effective sealing of the joint is not attained, the joint shall be disassembled, thoroughly cleaned, a new gasket inserted and joint reassembled.

3.05 MECHANICAL JOINTS:

- A. Assembling of fittings with mechanical joint ends shall conform to AWWA C600.
- B. If effective sealing of the joint is not attained at the maximum torque indicated in the above standard, the joint shall be disassembled and thoroughly cleaned, then reassembled. Bolts shall not be overstressed to tighten a leaking joint.

3.06 SLEEVE-TYPE COUPLINGS:

- A. Pipe ends shall be cleaned thoroughly prior to installation. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferable by use of a torque wrench of the appropriate size and torque for the bolts. The correct torque as indicated by a torque wrench shall not exceed 90 foot-lb.

3.07 QUALITY ASSURANCE

A. LEAKAGE TESTING FOR FORCE MAINS

1. Prior to the pressure and leakage tests, the piping shall be thoroughly flushed clean of all dirt, dust, oil, grease and other foreign material. This work shall be done with care to avoid damage to linings and coatings.
2. The installed pipe shall be pressure tested and leakage tested in accordance with AWWA Standard C600.
3. Unless otherwise approved, all pipelines shall be given a combined pressure and leakage tests between line valves. The Contractor shall furnish and install suitable temporary

testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gates, and other necessary equipment; and all labor required. The Owner or Engineer shall have the privilege of using their own gages.

4. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Contractor may make the tests when he desires.
5. Unless it has already been done, the section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. The Contractor shall follow established procedures for filling the pipe and expelling trapped air to avoid exposing the piping system to water-hammer. If blowoffs are not available at high points for releasing air, the Contractor shall excavate as required and install the necessary taps. If the Contractor changes the grade of pipe installation, he will be responsible for locating the taps at the correct location in the system for testing. Taps shall be installed at the beginning and end of each run. After completion of the test, if so required by the Engineer, he shall remove corporations used for testing; plug the holes and backfill as necessary.
6. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
7. The pressure shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test corrected to the gage location) to a pressure in pounds per square inch numerically equal to the pressure rating of the pipe (150 psi, unless otherwise noted). If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour, the section shall be considered as having failed to pass the pressure test.
8. If the pressure test fails, the Contractor shall make a leakage test by metering the flow of water into the pipe while maintaining in the section being tested a pressure equal to the pressure rating of the pipe. If the average leakage during a two-hour period exceeds a rate of 11.6 gallons per inch of diameter per 24 hours per mile of pipeline, the section shall be considered as having failed the leakage test. For example, if 1,000 feet of 12-inch pipe is to be tested, the allowable leakage is 2.2 gallons over a 2-hour period, calculated as follows:

$$L = \frac{(11.6 \text{ gal}) \times (12") \times (2 \text{ hr.}) \times (1000')}{(1") \times (24 \text{ hr.}) \times (5280')} = 2.2 \text{ gal}$$

9. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

END OF SECTION

SECTION 33 31 13.37

VALVES AND APPURTENANCES FOR WASTEWATER WORK

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers furnishing and installation of all outside valves and appurtenances as indicated on the drawings and as specified herein.

1.02 RELATED WORK:

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE
- B. Section 31 00 00, EARTHWORK
- C. Section 33 31 13.19, DUCTILE IRON PIPE AND FITTINGS

1.03 REFERENCES:

The following standards form a part of this specification, as referenced:

American Society for Testing and Materials (ASTM)

ASTM D429 Test Methods for Rubber Property - Adhesion to Rigid Substrates

American Water Works Association (AWWA)

AWWA C111 Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings

AWWA C509 Resilient Seated Gate Valves for Water Supply Service

AWWA C515 Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service

AWWA C550 Protective Interior Coatings for Valves and Hydrants

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF THE GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Shop drawings shall be submitted for valves and appurtenances, indicating type of joint, and lining and coating, etc., in accordance with the specifications.

- B. Shop drawings shall consist of manufacturer's scale drawings, or catalog cuts, including descriptive literature with complete characteristics and specifications, and code requirements.

PART 2 - PRODUCTS

2.01 RESILIENT SEATED GATE VALVES:

- A. Resilient seated, wedge type gate valves shall be manufactured to meet all applicable requirements of AWWA C509 or C515. Valves 12-inches and smaller shall be bubble-tight at 250 psi water working pressure, tested in both directions.
- B. Valve bodies shall be of cast or ductile iron and shall have non-rising threaded bronze stems acting through a bronze stem nut. Opening nuts shall be 2-inches square and shall open counterclockwise. All buried valves shall have mechanical joint ends in compliance with AWWA C111.
- C. Valve wedges shall be of cast iron with resilient seating surfaces permanently bonded to the wedges in strict accordance with ASTM D429 or attached to the face of the wedges with stainless steel screws. Each valve shall have a smooth, unobstructed water way free from sediment pockets.
- D. Valves shall have low friction, torque-reduction thrust bearings. All O-rings and gaskets shall be removable without taking the valves out of service.
- E. Valve body, bonnet and O-ring plate shall be coated both on interior and exterior with fusion bonded epoxy meeting applicable requirements of AWWA C550.
- F. Resilient seated gate valves shall be as manufactured by Clow Corporation, Oskaloosa, IA; Mueller Co., Chattanooga, TN; Kennedy Valve, Elmira, NY; or be an approved equal.

2.02 SEWAGE COMBINATION AIR VALVES:

- A. The sewage combination air valve (air and vacuum release) shall be single bodied, combining the operating features of both an air and vacuum valve and an air release valve. The air and vacuum orifice shall automatically release large volumes of air while the force main is being filled, and shall permit air to enter the force main under vacuum conditions, due to force main break or draining, to prevent force main collapse due to vacuum. The air release orifice shall be designed to open while pressurized, allowing entrapped air in the force main to escape independently of the air and vacuum orifice. The air release orifice shall be closed by a Buna-N needle mounted on a compound lever mechanism, until more air accumulates and the opening cycle repeats automatically.

- B. The Buna-N seat shall be fastened to the valve cover, without distortion for tight shutoff. All internals shall be easily removed through the top cover. The complete valve shall withstand 150 psi test.
- C. The valve inlet and outlet shall be sized as shown on the drawings. The valve shall have Buna-N needle and seat; stainless steel concave float and float mechanisms; cast iron body, cover, and baffle meeting ASTM A-48 Class 30 requirements; brass inlet and drain valves; and brass backflushing valve with quick disconnect coupling and minimum 5 foot rubber hose.
- D. The valve shall be APCO Series 440 Sewage Combination Air Valve, manufactured by APCO Valve and Primer Corp., Schaumburg, IL, or approved equal.
- E. The sewage combination air valve shall be completely assembled by the manufacturer, ready for installation by the Contractor.

2.03 VALVE BOXES:

- A. Each valve shall be provided with a box. Covers shall be close fitting and substantially dirt-tight. The top of the cover shall be flush with the top of the box rim and marked "Sewer".
- B. Valve boxes shall be of cast iron and of the adjustable threaded or sliding, heavy pattern type. They shall be so designed and constructed as to prevent direct transmission of traffic loads to the pipe or valve. The upper section of the box shall be provided with a flange having sufficient bearing area to prevent undue settlement. The lower section and stuffing box shall be designed to enclose the operating nut and stuffing box of the valve and rest on the backfill. The boxes shall be adjustable through at least 6-inches vertically without reduction of lap between sections to less than 4-inches.
- C. The inside diameter of boxes shall be at least 4-1/2-inches and the lengths shall be as necessary to suit the ground elevation and the depth of each valve.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. All material shall be carefully inspected for defects in workmanship and material, and all debris and foreign matter shall be cleaned out of valve openings and seats. Operating mechanisms shall be operated to check for proper functioning, and all nuts and bolts shall be checked for tightness.
- B. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.

- C. All valves shall be carefully installed and supported in their respective positions, free from all distortion and strain. Care shall be taken to prevent damage or injury to the valves and appurtenances during handling and installation.
- D. Valve boxes shall be set plumb, flush with the ground or paved surface, and centered directly over the operating nut of the valves. Earth fill shall be carefully tamped around the valve box to a distance of 4 feet on all sides of the box or to undisturbed trench faces if less than 4 feet.
- E. Valves shall be operational and accessible at all times during construction and warranty period. The Contractor shall verify the proper operation of all valves in the presence of the Engineer and/or Owner following completion of the project and prior to the acceptance of Substantial Completion.

END OF SECTION

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SECTION 33 31 13.46

CONNECTIONS TO EXISTING STRUCTURES

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish materials, tools, labor and equipment to cut suitable openings into the existing sewer manholes, make connections to existing sewers and all other work necessary to direct the existing sewage flow as indicated on the drawings and as herein specified.

1.02 RELATED WORK:

Section 33 39 13, PRECAST MANHOLES AND CATCH BASINS

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF THE GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Prior to start of work, submit details of the methods proposed for doing the work and for maintaining the sewage flow as herein specified.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. The Contractor shall provide temporary plugs or provide other suitable means for maintaining the new sewer free of sewage flow until such time as it can be inspected and tested for leakage.
- B. Connections to the new sewer shall be made when required by the Engineer and only after the new pipeline has been inspected and has successfully passed the leakage test.
- C. The Contractor shall modify each existing structure for installation of the necessary piping, but in so doing shall confine the cutting to the smallest amount possible consistent with the work to be done.
- D. All new piping connected to existing structures shall be encased in concrete in a manner satisfactory to the Engineer.
- E. All work shall be done with the proper tools and by careful workmen competent to do work.
- F. The Contractor shall cut, reshape and fill the existing manhole tables and plug existing outlets as indicated on the drawings and as required by the Engineer, to accommodate the

new connections. Reshaped manhole invert channels shall be smoothly shaped to permit the flow of sewage. Manhole invert channels shall be reconstructed as specified under Section 33 39 13, PRECAST MANHOLES AND CATCH BASINS.

END OF SECTION

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SECTION 33 32 13

SELF-PRIMING WASTEWATER PUMPING EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section of the specification includes, but is not limited to, furnishing and installing factory built simplex base mounted pump assemblies as indicated on the project drawings, herein specified, as necessary for proper and complete performance.

1.02 RELATED WORK:

- A. Precast utility building is included in Division 13.
- B. Concrete and concrete reinforcement is included in Division 3.
- C. Electrical work except as specified herein is included in Division 26.
- D. Painting is included in Division 9.
- E. Process integration is included in Division 40.

1.03 SYSTEM DESCRIPTION:

- A. Contractor shall furnish and install two factory-built base mounted, pump assemblies. The station shall be complete with all equipment specified herein, factory assembled on steel bases.
- B. Principal items of equipment shall include horizontal, self-priming, centrifugal sewage pumps, horizontal v-belt drives, motors, and valves.
- C. Factory built pump assembly design, including materials of construction, pump features, valves and piping, and motors shall be in accordance with requirements listed under PART 2 - PRODUCTS of this section.

1.04 QUALITY ASSURANCE:

- A. The pumps and pump assembly manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. The pump and pump assembly manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices,

technological advances, promoting environmental awareness and continual improvement.

- C. Upon request from the engineer, the pump assembly manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.
- D. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse-engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.
- E. The term "pump manufacturer" or "pump assembly manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warrants the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump assembly manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.
- F. Pump Performance Certifications
 - 1. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
 - a. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.
 - b. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.
 - c. Pump must reprime 15 vertical feet at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full

capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:

- 1) A check valve to be installed downstream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
 - 2) A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump assembly fitted with an air release valve.
 - 3) The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90 degree elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.
 - 4) Impeller clearances shall be set as recommended in the pump service manual.
 - 5) Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
 - 6) Liquid to be used for reprime test shall be water.
- d. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

G. Certified Pump Performance Test

1. Tests shall be conducted using a dynamometer in accordance with Hydraulic Institute Standards (ANSI/HI) 14.6.3.4 acceptance grade 2B. A minimum of five test points shall be measured. Test point data shall include flow, head, pump shaft input speed and torque. Efficiency and horsepower shall be calculated using the measured test point data. Performance test data evaluation shall be in accordance with ANSI/HI 14.6.3.4.2.

H. Factory System Test

1. All components including the pumps, motors, valves, and piping will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head and capacity per acceptance grade 2B. Factory operational test shall duplicate actual performance anticipated for the complete station.

2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer's facility.
- I. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.05 REFERENCES:

The latest editions of the following standards form a part of this specification:

- A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.
 1. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
 - a. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
 - b. ANSI/AWWA C115/A21.51 Cast/ductile iron pipe with threaded flanges.
 - c. ANSI 253.1 Safety Color Code for Marking Physical Hazards.
 - d. ANSI B40.1 Gages, Pressure and Vacuum.
 - e. AWWA C508 Single Swing Check Valves.
 2. American Society for Testing and Materials (ASTM)
 - a. ASTM A48 Gray Iron Castings.
 - b. ASTM A126 Valves, Flanges, and Pipe Fittings.
 - c. ASTM A307 Carbon Steel Bolts and Studs.
 - d. ASTM A36 Structural Steel.
 3. Institute of Electrical and Electronics Engineers (IEEE)
 - a. ANSI/IEEE Std 100 Standard Dictionary of Electrical Terms.
 - b. ANSI/IEEE Std 112 Test Procedure for Polyphase Induction Motors.
 - c. IEEE Std 242 Protection of Industrial and Control Power Systems.

4. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)
 - a. NEC National Electric Code.
 - b. NEC 701 National Electric Code article 701.
 - c. NEMA Std MG1 Motors and Generators.
5. Miscellaneous References
 - a. TR-16, Guides for the Design of Wastewater Treatment Works.
 - b. Env-Wq 700, New Hampshire Code of Administrative Rules, Standards of Design and Construction for Sewerage and Wastewater Treatment Facilities.
 - c. RSA 155, New Hampshire Building Code.
 - d. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
 - e. NMTBA and JIC Std. National Machine Tool Builders Association and Joint Industrial Council Standards.

1.06 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. Product Data

1. Prior to fabrication, pump assembly manufacturer shall submit submittal data in portable document format (.pdf) form and two (2) paper copies for review and approval.
2. Submittal shall include shop drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used shall be fully described.

- B. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for pump base. Contractor piping connections and station access clearances shall be dimensioned relative to the assembly centerline. Electric motor data shall be provided to extent necessary to validate function and integration of circuits to form a complete working system.

C. Operations Maintenance Manuals

3. Installation shall be in accordance with written instructions provided by the pump assembly manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
4. Documentation shall be specific to the pump assembly supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:
 - a. Functional description of each major component, complete with operating instructions.
 - b. Instructions for operating pumps in all modes of operation.
 - c. Calibration and adjustment of equipment for initial start-up, replacement of components, or as required for routine maintenance.
 - d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
 - e. Mechanical layout drawing of the pump base and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.
5. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Ship equipment and material complete except where partial disassembly is required by transportation regulations or for protection of components.
- B. Receive, store, and safeguard equipment and materials at the job site.

1.08 MANUFACTURER'S WARRANTY:

- A. The pump assembly manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
 - 1. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O rings, etc. The pump assembly manufacturer shall be solely responsible for warranty of the station and all components.
- B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.
- C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.
- D. Equipment supplied by others and incorporated into a pump assembly is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.
- E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report completed by an authorized manufacturer's representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 – PRODUCTS

2.01 UNITARY RESPONSIBILITY

- A. The pump assembly system integrator must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no

circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

2.02 MANUFACTURER

- A. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.
- B. In event the contractor obtains engineer's approval for equipment other than that manufactured by the Gorman-Rupp Company, the contractor shall, at his own expense, make all resulting changes to the buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating all changes required for the substituted equipment shall be submitted to the engineer prior to acceptance.
- C. Manufacturer shall be Gorman-Rupp Company, Vaughan Company, or approved equal.

2.03 PUMP PERFORMANCE

- A. Pumps shall be designed to meet the operating conditions provided in the following table:

#	Description	Value	Units
1.	Type of Pump	Self-Priming Centrifugal	
2.	Number of pumps	2	-
3.	Suction Size	4	IN
4.	Discharge Size	4	IN
5.	Motor Starter type	VFD/Soft Start	-
6.	Design Point #1: Flow capacity per pump	250	GPM
7.	Design Point #1: Total dynamic head	38	FT
8.	Min. efficiency at Design Point #1	43	%
9.	Max. Net Positive Suction Head Required	6.9	FT
10.	Max. re-priming static lift	19.6	FT
11.	Min. passable spherical solid diameter	3	IN
12.	Max. motor size	10	HP
13.	Max. motor speed	1,800	RPM
14.	Available power supply	480 V / 3 PH / 4 W	-

2.04 PUMP DESIGN

- A. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.
- B. The pump manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.
- C. Materials and Construction Features
 - 1. Pump casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:
 - a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
 - b. Fill port cover plate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.
 - c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
 - d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.
 - 2. Cover plate assembly shall be cast iron Class 30. Design must incorporate following maintenance features:
 - a. A lightweight inspection cover plate, retained by acorn nuts, for access to pump interior for removal of stoppages. Designs that require removal of complete cover plate assembly for access to the impeller will not be accepted.
 - b. Retained by acorn nuts for complete access to pump interior. Back cover plate removal must allow service to the impeller, seal, wear plate or check valve without removing suction or discharge piping. Back cover plate shall incorporate an obstruction free flow path by combining four support posts into a two-point "webbed" plate design for increased durability, reduced clogging, and increased operational efficiency.
 - c. Aggressive Self-Cleaning Wear Plate
 - 1) A replaceable wear plate secured to the back cover plate by studs and nuts. Wear plate shall be self-cleaning design ensuring that debris is cleared away and does not collect on the impeller vanes.

- 2) The nature of the conveyed medium poses significant challenges to the continuous operation of the pump. Of particular concern is the clogging of the impeller by debris in the pumped medium including but not limited to long rags, fibers, and like debris which are able to wrap around the impeller vanes, stick to the center of the vanes or hub, or lodge within the spaces between the impeller and the housing.
 - 3) The aggressive self-cleaning wear plate shall have integral laser cut notches and grooves in combination with a “tooth” designed to disturb and dislodge any solids which might otherwise remain on the impeller in dynamic operation. Wear plate is designed to constantly and effectively clear the eye of the impeller without the use of blades or cutters.
- d. In consideration for safety, a pressure relief valve shall be supplied in the inspection cover plate. Relief valve shall open at 75-200 PSI.
 - e. One O-ring of Buna-N material shall seal inspection cover plate to back cover plate.
 - f. Two O-rings of Buna-N material shall seal back cover plate to pump casing.
 - g. Pusher bolt capability to assist in removal of inspection cover plate or back cover plate. Pusher bolt threaded holes shall be sized to accept same retaining cap screws as used in rotating assembly.
 - h. Easy-grip handle shall be mounted to face of inspection cover plate.
3. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:
 - a. Seal plate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.
 - 1) The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
 - 2) The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.

- 3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
 - b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lock screw and conical washer.
 - c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.
 - d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
 - e. Shaft seal shall be cartridge oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be Viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.
 - f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same cap screws as used for retaining rotating assembly.
4. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means.
 - a. Clearances shall be maintained by a four-point external shimless cover plate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four-point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Cover plate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

- b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the cover plate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above
 - c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
5. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the cover plate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.
6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

D. Serviceability

- 1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs by incorporating the following features.
 - a. No special tools shall be required for replacement of any components within the pump.

E. Pump Drain Kit

- 1. The pump drain kit shall consist of a 10' length of plastic hose with a quick connect female Kamlock fitting on one end of hose and two sets of fittings for pump drains. Each set of fittings for pump drain includes a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and an aluminum quick connect male Kamlock fitting.

F. Spare Parts Kit

- 1. There shall be furnished with the pump assembly the following minimum spare parts:
 - a. One spare pump mechanical seal (complete), and with it all gaskets, seals, sleeves, O rings, and packing required to be replaced during replacement of the seal.
 - b. One set of impeller clearance adjustment shims.

- c. One set cover plate O ring.
- d. One rotating assembly O ring.

2.05 UNIT BASE

- A. The unit base shall be comprised of structural steel with a perimeter flange and reinforcements. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Perimeter flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump assembly unit during shipping and installation.

2.06 VALVES AND PIPING

- A. Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.
- B. Each pump shall be equipped with a plug valve. Plug valves shall be of the non-lubricated rectangular port; resilient-seated eccentric type with neoprene faced plugs and shall be furnished with flanged joint ends. Flanged valves shall be faced and drilled to ANSI B 16.1 Class 125. Valve bodies and plugs shall be made of ASTM A 126, Class B cast-iron. Valves shall have ports designed to pass spherical solids equal to the pump's capacity. All exposed nuts, bolts, springs, washers, etc., shall be zinc plated. Resilient plug facings shall be neoprene suitable for use with sewage. Valves shall be furnished with corrosion resistant seats, which comply with AWWA Standard C507 and with AWWA Standard C504. Valve shaft seals shall comply with AWWA Standard C507, and with AWWA C504 and shall be replaceable without valve or gear disassembly. Valves shall provide drip-tight shutoff up to the full pressure rating. All valves shall be hydrostatically pressure tested at 175 psi by the manufacturer. All valves shall be 100% full port design. All valves shall be operated with a single lever actuator providing lift, turn, and reseal action. The lever shall be equipped with a locking device to hold the plug in the desired position.

C. Manufacturer to review contract drawings for piping and valve layout at each station.

D. Automatic Air Release Valves

1. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric reinforced neoprene or similar inert material.
3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.
4. Valves shall be field adjustable for varying discharge heads.
5. Connection of the air release valves to the station piping shall include stainless steel fittings.

E. Gauge Kit

1. Each pump shall be equipped with a glycerin filled compound gauge to monitor suction pressures, and a glycerin filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4 inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Compound gauges shall be graduated 34 feet to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 140 feet water column minimum.
2. Gauges shall be mounted on a resilient panel and frame assembly which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.

F. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.
2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
4. Bolt holes shall be in angular alignment within 1/20 between flanges. Flanges shall be faced with a gasket finish.

G. Supports

1. Contractor must ensure all pipes connected to the pump assembly are supported to prevent piping loads from being transmitted to pumps or station piping. Pump assembly discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

2.07 DRIVE UNIT

A. Motors

1. Pump motors shall be 7.5 HP, 3 phase, 60 hertz, 208 VAC, horizontal ODP, 1800 RPM or less, NEMA design B with cast iron frame with copper windings, induction type, with class F insulation and 1.15 SF for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std 112.

B. Drive Transmission

1. Power to pumps transmitted V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.
2. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.
3. Precise alignment tolerances of the drive assemblies shall be achieved by means of a belt/sheave laser alignment system resulting in the reduction of vibration, accelerated wear, and premature failure.
4. The pump manufacturer shall submit power transmission calculations which document the following:
 - a. Ratio of pump/motor speed.
 - b. Pitch diameter of driver and driven sheaves.

- c. Number of belts required per drive.
- d. Theoretical horsepower transmitted per belt, based on vendor's data.
- e. Center distance between pump and motor shafts.
- f. Arc-length correction factor applied to theoretical horsepower transmitted.
- g. Service factor applied to established design horsepower.
- h. Safety factor ratio of power transmitted/brake horsepower required.

C. Belt Guards

- 1. Pump drive to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.
- 2. Guards must be completely removable without interference from any unit component, and shall be securely fastened and braced to the unit base.
- 3. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.
- 4. The guard shall be finished with one coat of gray W.R. non-lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

2.09 FINISH

- A. Pumps, piping and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before paint application. Open joints shall be caulked with an approved polyurethane sealant. Exposed surfaces shall be applied with one coat of Tnemec Series 69 Polymide Epoxy Primer and one finish coat of Series 73 Aliphatic Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a topcoat or touch-up coating.

PART 3 – EXECUTION

3.01 INSTALLATION:

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- A. Installation of the pump assembly and related appurtenances shall be performed in accordance with written instructions by the manufacture.
- B. Contractor shall clean all surface coatings damaged in shipment or installation and touch up in field with the same materials as original coatings.
- C. Install, level, align, and lubricate pump assembly as indicated on project drawings.
- D. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.
- E. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.
- F. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.02 FIELD ACCEPTANCE TESTS:

- A. After installation, all piping shall be tested for tightness in an approved manner. Piping between the wetwell and the pump chamber shall be pressure tested after backfilling and before any structures are constructed above. Should leaks be found, faulty joints shall be repaired, even to the extent of disassembling and remaking the joints, and all defective pipe and fittings shall be removed and replaced in a manner satisfactory to the Engineer.
- B. After installation of the equipment and after completion of the services of the manufacturer's representative as detailed in Section 01 14 00 SPECIAL PROVISIONS, the Contractor shall operate each unit to demonstrate its ability to pump without excessive vibration, motor overloading, or overheating. Each pump shall be operated for a sufficient period of time to permit thorough observation of all pump components.
- C. The start-up and testing shall be conducted in accordance with Section 01 75 00 STARTUP AND TESTING FOR SEWER PUMP STATIONS.
 - 1. Coordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

2. Notify Engineer in writing at least three days in advance. If testing cannot be conducted because of scheduling or lack of service personnel, Engineer's fees for second visit shall be paid by the Contractor
- D. Performance tests shall be conducted on the pumping units installed. The tests shall be conducted for the operating point (flow versus head capacity), overall system efficiency, and overall system power requirements. These parameters shall be measured, documented in writing, and delivered to the Engineer.
 - E. Pump(s) are equipped with Variable Frequency Drives, the pump(s) shall be run at its shutoff head for a period of at least one (1) minute at each VFD speed from 60% to 100% at 10% intervals. The pump shall be run at its maximum rating point for a period of at least thirty (30) minutes.
 - F. All pumping equipment shall be tested to check for proper operation, proper alignment, faulty equipment, and for excessive vibration. The Contractor shall provide vibration testing by a qualified and independent testing company. This testing of the complete system shall cover all duty conditions outlined in this Section of the Specifications. The vibration testing shall be conducted in the presence of the pump and pump motor field service representatives in accordance with procedures outlined in the applicable sections of the Hydraulic Institute Standards and Section 01 75 13 EQUIPMENT CHECKOUT AND TESTING, of these specifications.
 - G. In the event vibration exceeds the specified limits and the cause of the vibration is attributable to the pumping equipment, the equipment manufacturers shall make the necessary balancing or alignment adjustments to bring the equipment to within the specified limits.
 - H. At the discretion and expense of the Owner, an independent vibration analysis may be conducted on the new wastewater pump. The Contractor and manufacturer will be permitted to witness the test.
 - I. The completed pump and motor installation shall be tested for sound generation in accordance with the Hydraulic Institute Standards for sound measurement from pumping equipment.
 - J. Any and all alterations, modifications, additions and/or work necessary to rectify defects or non-conformance with this Section of the Specification shall be done in such a manner as to provide for the satisfactory operation of the pumps and pump motors, at no additional cost to the Owner.
 - K. All defects or defective equipment shall be corrected or replaced promptly at the Contractor's expense.
 - L. All final adjustments necessary to place the equipment in satisfactory working order shall be made prior to the tests.

- M. If sufficient sewage is not available for the test, the Contractor shall provide water for testing. All labor and materials necessary for the test shall be furnished by the Contractor.

END OF SECTION

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SECTION 33 39 13

PRECAST MANHOLES

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers all precast manholes complete, including, but not limited to, bases, walls, cones, mortar, inverts, frames and covers.

1.02 RELATED WORK:

- A. Section 31 00 00, EARTHWORK
- B. Division 3, CONCRETE

1.03 SYSTEM DESCRIPTION:

- A. Precast sections shall conform in shape, size, dimensions, materials, and other respects to the details indicated on the drawings or as required by the Engineer.
- B. All manholes shall have concrete bases. Concrete bases shall be precast unless otherwise specified. Invert channels shall be formed of brick and mortar upon the base.
- C. Riser and cone sections shall be precast concrete.

1.04 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM A48	Gray Iron Castings
ASTM C32	Sewer and Manhole Brick
ASTM C144	Aggregate for Masonry Mortar
ASTM C207	Hydrated Lime for Masonry Purposes
ASTM C478	Precast Reinforced Concrete Manhole Sections
ASTM C923	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes

ASTM C1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M198 Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

Occupational Safety and Health Administration

OSHA 29 CFR 1910.27 Fall Prevention Protection

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of manufacturer literature of the materials of this section shall be submitted to the Engineer for review.
- B. Test reports as required shall be submitted to the Engineer.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE SECTIONS:

A. All precast concrete sections shall conform to ASTM C478 with the following exceptions and additional requirements:

- 1. The wall thickness of precast sections shall be as designated on the drawings, meeting the following minimum requirements:

<u>Section Diameter (Inches)</u>	<u>Minimum Wall Thickness (Inches)</u>
48	5
60	6
72	7
84	8

- 2. Type II cement shall be used except as otherwise approved.
- 3. Sections shall be steam cured and shall not be shipped until at least five days after having been cast.
- 4. Minimum compressive strength of concrete shall be 4000 psi at 28 days.
- 5. No more than two lift holes may be cast or drilled in each section.

6. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section.
 7. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.
 8. Circumferential steel reinforcement in walls and bases shall be a minimum of 0.12 sq. in./lin. ft. for 4-foot diameter sections and 0.15 sq. in./lin. ft. for 5- and 6-foot diameter sections. Reinforcing shall extend into tongue and groove.
- B. Conical reducing sections shall have a wall thickness not less than 5-inches at the bottom and wall thickness of 8-inches at the top. Conical sections shall taper from a minimum of 48-inches diameter to 24 or 30-inches diameter at the top, as shown on the drawings.
 - C. Except where insufficient depth of cover dictates the use of a shorter base, bases shall be a minimum of 4 feet in height.
 - D. Slab top sections and flat riser sections (Grade Rings) shall conform to the contract drawings, with particular attention focused upon the reinforcing steel and be designed to meet or exceed an HS-20 Loading requirement.
 - E. The tops of the bases shall be suitably shaped by means of accurate ring forms to receive the riser sections.
 - F. Precast sections shall be manufactured to contain wall openings of the minimum size to receive the ends of the pipes, such openings being accurately set to conform with line and grade of the sewer or drain. Subsequent cutting or tampering in the field, for the purpose of creating new openings or altering existing openings, will not be permitted except as required by the Engineer.
 - G. The exterior surfaces of all precast manhole bases, walls, and cones shall be given a minimum of one shop coat of bituminous damp-proofing.
 - H. The Engineer reserves the right to reject any unsatisfactory precast section and the rejected unit shall be tagged and removed from the job site immediately.
 - I. The Engineer may also require the testing of concrete sections as outlined under Physical Requirements in ASTM C478 with the Contractor bearing all testing costs.

2.02 BRICK MATERIALS:

- A. Brick shall be sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. Bricks shall comply with ASTM C32, for Grade SS, hard brick, except that the mean of five tests for absorption shall not exceed 8 percent by weight.

- B. Rejected brick shall be immediately removed from the work and brick satisfactory to the Engineer substituted.
- C. Mortar shall be composed of Portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as required by the Engineer and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for Grade SS Brick shall be mixed in the volume proportions of 1:1/2:4-1/2; Portland cement to hydrated lime to sand.
- D. Cement shall be Type II Portland cement as specified for concrete masonry.
- E. Hydrated lime shall be Type S conforming to ASTM C207.
- F. The sand shall comply with ASTM C33 specifications for "Fine Aggregate," except that all of the sand shall pass a No. 8 sieve.

2.03 FRAMES, GRATES AND COVERS:

- A. Castings shall be of good quality, strong, tough, even-grained cast iron, smooth, free from scale, lumps, blisters, sandholes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers.
- B. All castings shall be thoroughly cleaned and may be subject to a careful hammer inspection at the Engineer's discretion.
- C. Castings shall be ASTM A48 Class 30B or better.
- D. Frames and covers shall be City of Rochester standard by ej Product (Number) 2006A1/2006Z (00200628/00200611 or approved equal.

2.04 SEWER MANHOLE ACCESSORIES:

- A. Gasket materials shall be top grade (100% solids, vulcanized) butyl rubber and shall meet or exceed AASHTO M-198.
- B. Couplings at the manhole-pipe interface shall be made with a rubber seal system (with or without stainless steel straps) meeting the requirements of ASTM C923 and recommended for this type of connection.
- C. Stubs installed as specified and indicated on the drawings shall be short pieces of the same class pipe as that entering the manhole and shall have either stoppers or end caps as shown on the drawings. Stoppers or end caps shall be especially designed for that application.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. PRECAST SECTIONS:

1. Precast bases shall be supported on a compacted level foundation of crushed stone, as specified in Section 31 00 00 EARTHWORK, at least 6-inches thick, but shall vary to the depth necessary to reach sound undisturbed earth.
2. Precast reinforced concrete sections shall be set vertical and with sections in true alignment.
3. Double rows of butyl rubber joint sealant shall be installed between each concrete section.
4. All holes used for handling the sections and section joints shall be thoroughly plugged with hydraulic cement. Cement shall be mixed slightly damp to the touch (just short of "balling"), hammered into the holes until it is dense and an excess of paste appears on the surface, and then finished smooth and flush with the adjoining surfaces.

B. BRICK WORK:

1. Bricks shall be moistened by suitable means, as required, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
2. Each brick shall be laid as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as directed.
3. The brick inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipe.

C. CASTINGS:

1. Ductile frames, grates and covers shall be as specified. The frames and covers shall be set by the Contractor to conform accurately to the grade of the finished pavement, existing ground surface, or as indicated on the drawings. Frames shall be adjusted to meet the street surface.
2. Ductile manhole frames and covers not located in paved areas shall be set 6-inches above finished grade, at a height as required by the Engineer, or as indicated on the drawings. The top of the cone shall be built up with a minimum of 1 course and a maximum of 5 courses of brick and mortar used as headers for adjustment to final grade.

3. Frames shall be set concentric with the top of the concrete section and in a full bed of mortar so that the space between the top of the concrete section or brick headers and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the bottom flange. The mortar shall be smoothly finished to be flush with the top of the flange and have a slight slope to shed water away from the frame.
4. Covers and/or grates shall be left in place in the frames, for safety reasons, except while work is being performed.
5. Cross Country Installation: Manholes frame and covers shall be installed at grade in lawns or above grade in cross country areas, unless specified otherwise on the plans.

D. ACCESSORIES:

1. Accessories shall be installed in accordance with manufacturer's instructions.
2. Stubs shall be set accurately to the dimensions indicated on the drawings. Stubs shall be sealed with suitable watertight plugs.

3.02 LEAKAGE TESTS:

- A. Leakage tests shall be made by the Contractor and observed by the Engineer on each manhole. Manholes shall be tested for leakage using a vacuum test in accordance with NHDES Env-Wq 704.17 and below.

B. VACUUM TEST:

1. The vacuum test shall be conducted in accordance with ASTM C1244. Test results will be judged by the length of time it takes for the applied vacuum to drop from 10 inches of mercury to 9 inches. If the time is less than that listed in Table 1 of ASTM C1244, the manhole will have failed the test. Test times from Table 1 are excerpted below.

TABLE 1

Minimum Test Times for Various Manhole Diameters

Depth (Feet)	Diameter (Inches)		
	48	60	72
	<u>Times (Seconds)</u>		
0-10	120	120	120
10-15	150	150	150
>15	180	180	180

2. If the manhole fails the initial test, the Contractor shall locate the leaks and make proper repairs. Leaks may be filled with a wet slurry of accepted quick setting material. If the manhole should again fail the vacuum test, additional repairs shall be made, and the manhole water tested as specified.

3.03 CLEANING:

All new manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

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SECTION 33 39 13.13

REBUILD SANITARY SEWER MANHOLE BENCH AND INVERT

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers manholes benches and inverts complete, including, but not limited to, bases, mortar, benches and inverts.

1.02 RELATED WORK:

- A. Section 01 12 16, SCOPE AND SEQUENCE OF WORK
- B. Section 01 33 23, SUBMITTALS
- C. Section 01 33 19, DOCUMENTATION
- D. Section 01 14 19.22, HANDLING EXISTING FLOWS

1.03 SYSTEM DESCRIPTION:

- A. Invert channel and bench shall be formed of brick and mortar upon the base.

1.04 REFERENCES:

- A. The following standards form a part of this specification as referenced:

ASTM International (ASTM)

ASTM C32	Sewer and Manhole Brick
ASTM C144	Aggregate for Masonry Mortar
ASTM C207	Hydrated Lime for Masonry Purposes
ASTM C923	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
ASTM C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23
SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer literature of the materials of this section shall be submitted to the Engineer for review.
- B. Tests reports as required shall be submitted to the Engineer.

PART 2 – PRODUCTS

- 2.01 The bench and invert shall be formed of brick and mortar, as specified in this specification section.
- 2.02 BRICK MATERIALS:
 - A. Brick shall be sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. Bricks shall comply with ASTM C32, for Grade SS, hard brick, except that the mean of five tests for absorption shall not exceed 8 percent by weight.
 - B. Rejected brick shall be immediately removed from the work and brick satisfactory to the Engineer substituted.
 - C. Mortar shall be composed of portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as required and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for Grade SS Brick shall be mixed in the volume proportions of 1:1/2:4-1/2; portland cement to hydrated lime to sand.
 - D. Cement shall be Type II portland cement as specified for concrete masonry.
 - E. Hydrated lime shall be Type S conforming to ASTM C207.
 - F. The sand shall comply with ASTM C144 specifications for "Fine Aggregate," except that all of the sand shall pass a No. 8 sieve.

PART 3 - EXECUTION

- 3.01 INSTALLATION:
 - A. Bench and Invert Brick Work:
 - 1. All debris and deteriorated brick, block, and mortar shall be removed from the bottom of the manhole before the bench and invert are rebuilt.
 - 2. Bricks shall be moistened by suitable means, as required, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.

3. Each brick shall be laid as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as required.
4. The brick bench and invert shall conform accurately to the size of the manhole and adjoining pipes. Side inverts shall be curved, and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipe.

3.02 CLEANING:

All manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

SECTION 40 05 13.53

PROCESS PIPE AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers furnishing, laying, jointing, and testing of process pipe within the pump station, including fittings, special castings and appurtenant work, as indicated on the drawings and as specified.

1.02 RELATED WORK:

- A. Section 09 90 00, PAINTING
- C. Section 33 11 13.13, DUCTILE IRON PIPE AND FITTINGS
- D. Section 40 05 23, VALVES AND APPURTENANCES FOR WASTEWATER PROCESSES

1.03 QUALITY ASSURANCE:

- A. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured.
- B. The Owner reserves the right to have any or all pipe, fittings, and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

1.04 REFERENCES:

The following standards form a part of this specification and indicate the minimum standards required:

American National Standards Institute (ANSI)

- ANSI A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- ANSI A21.10 Ductile-Iron and Gray-Iron Fittings, 3-inches through 48-inches, for Water and Other Liquids
- ANSI A21.11 Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- ANSI A21.15 Flanged Ductile-Iron Pipe with Threaded Flanges
- ANSI A21.50 Thickness Design of Ductile-Iron Pipe

ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast in Metal or Sand-Lined Molds for Water or Other Liquids

ANSI A21.53 Ductile-Iron Compact Fittings, 3 inch Through 16 inch., for Water and Other Liquids.

American Water Works Association (AWWA)

AWWA C606 Standard for Grooved and Shouldered Joints

AWWA C651 Standard for Disinfecting Water Mains

American Society for Testing and Materials (ASTM)

ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless

ASTM A307 Low-Carbon Steel, Externally and Internally Threaded Standard Fasteners

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Shop drawings consisting of manufacturer's scale drawings, cuts, or catalogs including descriptive literature and complete characteristics and specifications and code requirements. Shop drawings shall be submitted for the ductile iron pipe, type of joint, fittings, couplings, filling rings, and lining and coating in accordance with specifications.
- B. Sworn certificates verifying the results of tests called for in subsection 1.03, Quality Assurance.
- C. Pipe support design calculations stamped and approved by a Professional Engineer registered in the state where the project is located.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE:

- A. All ductile iron pipe shall be designed in accordance with ANSI A21.50 and shall be manufactured in accordance with ANSI A21.51.
- B. Pipe for use with sleeve type couplings shall be as specified above except that the ends shall be plain (without bells or beads). The ends shall be cast or machined at right angles to the axis.
- C. Pipe for use with grooved type couplings shall have ends grooved in accordance with AWWA C606.

- D. Pipe thickness class, unless otherwise indicated:
 - 1. Minimum thickness class shall be Class 53 for use with threaded flanges.
 - 2. For grooved couplings, minimum thickness class shall be Class 53 for pipe smaller than 18-inches and Class 56 for pipe 18-inches and larger.
- E. Machined surfaces shall be cleaned and coated with a suitable rust-preventative coating at the shop immediately after being machined.
- F. The inside of pipe and fittings shall be given a cement lining and bituminous seal coat in accordance with ANSI A21.4. The thickness of lining shall be double that specified in the above referenced specification.
- G. The outside of pipe and fittings within structures shall not be coated with the bituminous coating, but shall be thoroughly cleaned as recommended by the coating manufacturer and given one shop coat of 69-1211 H.B. Epoxoline II primer made by Tnemec Company, Inc.; Multiprime made by Pittsburgh Plate Glass Co., Pittsburgh, PA; Recoatable Epoxy Primer B67H5/R5 made by Sherwin-Williams Company; or an approved equal product.

2.02 JOINTS:

- A. Flanged joints shall conform to ANSI A21.15 except that special drilling or tapping shall be provided as necessary to ensure correct alignment and bolting.
- B. Flanged pipe shall use long-hub flanges which shall be screwed on tight at the foundry by machine before they are faced and drilled.

2.03 FITTINGS:

- A. Fittings shall conform to the requirements of ANSI A21.10 and shall be of a pressure classification at least equal to that of the pipe with which they are used.
- B. Flanged fittings shall be faced and drilled in accordance with ANSI A21.10 except that special drilling or tapping shall be provided as necessary to ensure correct alignment and bolting.
- C. Provide ductile-iron grooved-end fittings conforming to ANSI A21.10 for center-to-face dimensions.
 - 1. End preparation for grooved-ends conforming to AWWA C606 for flexible or rigid joints as required by type of joint.
 - 2. Minimum wall thickness of grooved fittings 12-inch and smaller conforming to ANSI A21.53.

3. Minimum wall thickness of grooved fittings larger than 12-inch conforming to ANSI A21.10.

D. Fittings shall be provided with standard bosses where so indicated.

2.04 SLEEVE TYPE COUPLINGS:

A. To ensure correct fitting of pipe and couplings, all flexible couplings and accessories shall be furnished by the supplier of the pipe and shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.

B. Flexible couplings shall be Style 38 by Dresser Mfg. Div., Bradford, PA; Style 441 Smith-Blair, Inc., San Francisco, CA; R.H. Baker & Co., Inc., Huntington Park, CA; Clow Corporation, Rochester, NY; or approved equal products.

C. All couplings shall be furnished with the pipe stop removed.

D. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

2.05 GROOVED COUPLINGS:

A. Couplings shall conform to AWWA C606.

B. Minimum pipe wall thickness shall be as specified under "Pipe For Use With Couplings."

C. Unless otherwise indicated, when grooved couplings are used, joint to be of rigid type with pipe grooves cut to bring pipe ends together. Beam strength of joint shall be equal to or greater than that of flanged joint. Flexible type joint to be used only as specified or indicated.

D. Where grooved couplings are indicated to provide for expansion or flexibility, cut pipe grooves to provide necessary expansion or flexibility.

2.06 WALL PENETRATIONS:

A. RESTRAINED:

1. Where restrained wall penetrations are called for on the drawings, wall pipe castings with integral water stops shall be used. Outside surfaces of castings to be encased in concrete shall not be painted or coated.

2. OMNI*SLEEVE as manufactured by OMNI*SLEEVE, Cream Ridge, NJ, or approved equal shall be an accepted alternate when installed with retainer (tie) rods.

3. Wall sleeves with mechanical seals only will not be allowed in lieu of castings.

B. NON-RESTRAINED:

Where non-restrained wall penetrations are called for on the drawings, mechanical seals shall fill the space between the process pipe and the pipe sleeve to create a water tight seal. Mechanical seal shall be Link-Seal by Thunderline Corporation, Wayne, Michigan; Sure Seal by International Piping Systems, Inc., Saugus, Massachusetts; OMNI*SLEEVE, by OMNI*SLEEVE of Cream Ridge, NJ; or approved equal.

2.07 FILLING RINGS:

The Contractor shall provide suitable filling rings where the layout of the flanged piping is such as to necessitate their use. In materials, workmanship, facing and drilling, such rings shall conform to the 125-lb. ANSI Standard. Filling rings shall be of suitable length with nonparallel faces and corresponding drilling if necessary, to ensure correct assembly of the adjoining piping or equipment.

2.08 GASKETS, BOLTS, AND NUTS:

- A. For flanged joints, gaskets shall be a minimum of 1/8-inch thick full face gaskets.
- B. Gaskets shall be of a composition suitable for exposure to the liquid within the pipe.
- C. Flanged joints shall be either made with bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges. Bolts and nuts shall, except as otherwise specified or noted on the drawings, be heavy hex Grade B conforming to ASTM A307. Bolt studs and studs shall be of the same quality as machine bolts.

2.09 JOINT RESTRAINT:

- A. Where indicated or necessary to prevent joints or flexible couplings from pulling apart under pressure, suitable socket pipe clamps, tie rods, and bridles shall be provided. Bridles and tie rods shall be at least 3/4-inch diameter except where they replace flange bolts of smaller size, in which case they shall be fitted with a nut on each side of the pair of flanges. The socket clamps and tie rods or bridles shall be coated with an approved primer paint after assembly, or, if necessary, prior to assembly.

2.10 RESTRAINED FLANGE ADAPTER:

- A. Restrained flange adapter shall be used in lieu of threaded or welded flanged spool pieces. Flanged adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.20 (125#/Class 150 Bolt Pattern).
- B. Restraint for flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

- C. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum of 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
- D. All internal surfaces of the gasket ring (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. The coating shall meet ANSI/NSF-61. Exterior surfaces of the gasket ring shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
- E. The flange adapter shall be the Series 2100 MEGAFLANGE Restrained Flange Adapter as produced by EBBA, Inc., or approved equal.

PART 3 - EXECUTION

3.01 HANDLING AND CUTTING PIPE:

- A. Any pipe or fitting which has a damaged lining, scratched or marred machine surface, and/or abrasion of the pipe coating or lining shall be rejected and removed from the job site.
- B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used may be perfectly sound. The cut shall be made in the sound barrel at a point at least 12-inches from the visible limits of the crack.
- D. Except as otherwise approved, all cutting shall be done with a machine suitable for cutting ductile iron pipe. Hydraulic squeeze cutters are not acceptable. Travel type cutters or rotary type abrasive saws may be used. All cut ends shall be examined for possible cracks caused by cutting.
- E. The Contractor's attention is directed to the fact that damage to the lining of pipe or fittings will render them unfit for use; he shall use the utmost care in handling and installing lined and coated pipe and fittings to prevent damage. Protective guards shall not be removed until the pipe is to be installed.
- F. Lined and coated pipe and fittings shall be assembled and installed with approved packing or gaskets of the type recommended by the pipe manufacturer for the particular lining used.
- G. Castings to be encased in masonry or concrete shall be accurately set with the bolt holes, if any, carefully aligned. OMNI*SLEEVE shall be installed per manufacturer's instructions.

- H. Immediately prior to being set, castings shall be thoroughly cleaned of all rust, scale and other foreign matter.

3.02 INSTALLING PIPE AND FITTINGS:

- A. No defective pipe or fittings shall be laid or placed in the piping, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.
- B. Pipes and fittings shall be subjected to a careful inspection and a hammer test just before being installed.
- C. Before the pieces are assembled, rust-preventive coatings shall be removed from machined surfaces. Pipe ends, sockets, sleeves, housings, and gaskets shall be thoroughly cleaned and all burrs and other defects shall be carefully smoothed.
- D. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the completed work.
- E. Flanged joints shall be made up tight, care being taken to prevent undue strain upon pump nozzles, valves, and other pieces of equipment.
- F. Pipe and fittings shall be laid accurately to the lines and grades indicated on the drawings or as required by the Engineer. Care shall be taken to ensure good alignment both horizontally and vertically.
- G. Castings to be encased in masonry shall be accurately set with the bolt holes, if any, carefully aligned.
- H. Immediately prior to being set, castings shall be thoroughly cleaned of all rust, scale and other foreign material.

3.03 ASSEMBLING SLEEVE TYPE COUPLINGS:

- A. Prior to the installation of flexible couplings, the pipe ends shall be cleaned thoroughly for a distance of 8-inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6-inches from the end, and the middle ring shall be placed on the already laid pipe and until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares.
- B. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.
- C. The correct torque as indicated by a torque wrench shall not exceed 90 foot-pounds.

3.04 ASSEMBLING GROOVED COUPLINGS

- A. Clean grooves and other parts.
- B. Coat ends of pipe and outside of gasket with soft soap or silicone and slip gasket over one pipe end.
- C. Bring pipes to correct position and center gasket over pipe ends with lips against pipe.
- D. Place housing section, insert bolts and tighten nuts until housing sections are in metal-to-metal contact.
- E. If grooves must be cut in the field, the equipment used shall be as recommended by the coupling manufacturer. Finished grooves shall comply with AWWA C606.

3.05 PIPING SUPPORT:

- A. The Contractor shall furnish and install all supports necessary to hold the piping and appurtenances in a firm, substantial manner at the lines and grades indicated on the drawings or specified. Pipe supports shall be furnished with one shop coat of rust inhibitive primer.
- B. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit a certification from the manufacturer stating that such requirements have been complied with.
- C. Piping within buildings shall be adequately supported from floors, walls, ceilings or beams. Supports from the floor shall be by approved saddle stands, or suitable concrete piers as indicated or approved. Pipe saddles shall be shaped to fit the pipe with which they will be used and shall be capable of screw adjustment. Brick and concrete piers shall conform accurately to the bottom one-third to one-half of the pipe. Piping along walls shall be supported by approved wall brackets with attached pipe rolls or saddles or by wall brackets with adjustable hanger rods. For piping supported from the ceiling, approved rod hangers of a type capable of screw adjustment after erection of the piping and with suitable adjustable concrete inserts or beam clamps shall be used.

3.06 TAPPED CONNECTIONS:

- A. Tapped connections in pipe and fittings shall be made so as to provide a watertight joint and adequate strength against pullout. The maximum size of taps in pipe or fittings without bosses shall not exceed that listed in the appropriate table of the Appendix to the ANSI A21.51, based on 3 full threads for ductile iron.
- B. Where the size of the connection exceeds that given above, a boss shall be provided on the pipe barrel and the tap shall be made in the flat part of the intersection of the run and branch of a tee or cross, or the connection shall be made by means of a tapped tee, branch

fitting and tapped plug or reducing flange, or tapping tee and tapping valve, all as indicated or approved.

All drilling and tapping of ductile iron pipe shall be done normal to the longitudinal axis of the pipe; fittings shall be drilled and tapped similarly, as appropriate. Drilling and tapping shall be done only by skilled mechanics. Tools used shall be adapted to the work and in good condition so as to produce good, clean-cut threads of the correct size, pitch, and taper.

3.07 PRESSURE AND LEAKAGE TESTS:

- A. Prior to the pressure and leakage tests, the piping shall be thoroughly cleaned of all dirt, dust, oil, grease and other foreign material. This work shall be done with care to avoid damage to linings and coating.
- B. Except as otherwise required by the Engineer, all pipelines shall be given combined pressure and leakage tests in sections of approved length. The Contractor shall furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gates, and other necessary equipment; and all labor required. The Owner or Engineer may monitor the tests using their own gages.
- C. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Contractor may make the tests when he desires.
- D. The section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If hydrants and blowoffs are not available at high points for releasing air, the Contractor shall make the necessary taps at such points, including required excavation and backfilling, and shall plug said holes after completion of the test.
- E. The section under test shall be maintained full of water for 24 hours prior to the combined pressure and leakage test being applied.
- F. The pressure and leakage test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test, corrected to the gage location) to a pressure in pounds per square inch numerically equal to the pressure rating of the pipe. If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour, the section shall be considered as having failed to pass the pressure test.
- G. Following or during the pressure test, the Contractor shall conduct a leakage test by metering the flow of water into the pipe while maintaining pressure equal to the pressure rating of the pipe. If the average leakage during a two-hour period exceeds a rate of 11.6 gallons per inch of diameter per 24 hours per mile of pipeline, the section shall be considered as having failed the leakage test.
- H. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

- I. If, in the judgment of the Engineer, it is impracticable to exactly follow the foregoing procedure, modifications in the procedure may be made as required and approved. The Contractor will still be responsible for providing a line, which satisfies the above leakage and pressure requirements.

END OF SECTION

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SECTION 40 05 23

VALVES AND APPURTENANCES
FOR WASTEWATER PROCESSES

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish and install valves and appurtenances as indicated on the drawings and in the specifications and as herein specified, including all labor, material, equipment and incidentals required. All valves shall open counterclockwise unless otherwise indicated.

1.02 RELATED WORK:

- A. Section 09 90 00, PAINTING
- B. Section 40 05 13.53, PROCESS PIPE AND FITTINGS

1.03 QUALITY ASSURANCE:

Insofar as possible, gate, ball, butterfly, globe, angle and check valves shall be the product of one manufacturer who has had long experience in the design of valves and whose products have proven reliable in service in similar installations over a reasonable period of years. The valves shall be designed so that parts subjected to wear may be easily replaced and shall be constructed of wear-resistant materials.

1.04 REFERENCES:

- A. The following standards form a part of this specification, as referenced:

American National Standards Institute (ANSI)

- | | | |
|------|--------|---|
| ANSI | B16.1 | Cast Iron Pipe Flanges and Flanged Fittings, Class 125. |
| ANSI | B16.10 | Standard Face-to-Face and End-to- End Dimensions of Ferrous Valves. |

American Water Works Associations (AWWA)

- | | | |
|------|------|---|
| AWWA | C500 | Gate Valves for Ordinary Water Works Service. |
|------|------|---|

Federal Specifications (FS)

FS	WW-V-54C	Amendment 1, Type I or II, Class A for Valve Gate, Bronze (125, 150 and 200 lb., Screwed, Flanged Solder - End, for Land Use).
FS	WW-V-51D	Valve, Bronze, Angle, Check and Globe 125, 150 and 200 Pound Screwed, Flanged or Solder-End (For Land Use)
FS	WW-V-35C	Valve, Ball
FS	TT-V-51F	Varnish, Asphalt

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

Complete shop drawings plus operating and maintenance instructions for each item furnished.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. All hand wheels, operating nuts and key stops shall be turned counterclockwise to open the valves. Handwheels shall be of ample size and shall have an arrow and the word "open" cast thereon to indicate the direction of opening.
- B. Valves to be buried shall be designed for buried service and shall be provided with gate boxes and tee handle operating wrenches in the number and lengths necessary to permit operation of all valves by operator of average height, working in normal standing positions. At least two (2) of each type, size and length of wrench shall be provided, unless otherwise stated below. Operating nuts for use with tee handle operating wrenches shall be 2-inches square, and conform to the appropriate AWWA Standard.
- C. Where indicated on the drawings or necessary due to location, size, or inaccessibility, geared or chain wheel operators shall be furnished with the valves. Such operators shall be designed to have adequate strength for use with the valves with which they are supplied.
- D. As indicated on the drawings, certain valves or gates require floorstands and/or bench-stands.
- E. Unless otherwise specified in the specifications or on the drawings, all flanged valves shall conform to ASA Specification B16.1 and ANSI Specification B16.10.
- F. It shall be the Contractor's responsibility to make the valve or gate manufacturer aware of the type of service to which the valve or gate will be subjected and the nature of the materials (i.e. sewage, sludge, chemicals, etc.) which it will handle, and to make sure that all materials used in the manufacture of the valve or gate are suitable for the use intended.

- G. All anchor bolts and embedded items for complete installation or mounting, holding down or supporting of equipment to be furnished under this section, including necessary location drawings and templates required to install the items in concrete, masonry, etc., shall be furnished and delivered to the site by the manufacturer of the equipment furnished under this section, for installation under other sections of these specifications. Delivery of the items shall be as required by the overall construction schedule.
- H. These specifications direct attention to certain features but do not purport to cover all details entering into the design of the equipment. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness, and to be especially adapted for the work done.

2.02 PLUG VALVES:

- A. Plug valves shall be of the non-lubricated rectangular port; eccentric type with neoprene faced plugs and shall be furnished with flanged joint ends. Flanged valves shall be faced and drilled to ANSI B 16.1 Class 125. Valve bodies and plugs shall be made of ASTM A 126, Class B cast-iron. All exposed nuts, bolts, springs, washers, etc., shall be zinc plated. Resilient plug facings shall be neoprene suitable for use with sewage. Valves shall be furnished with corrosion resistant seats, which comply with AWWA Standard C507 and with AWWA Standard C504. Valve shaft seals shall comply with AWWA Standard C507, and with AWWA C504 and shall be replaceable without valve or gear disassembly.
- B. Valves shall provide drip-tight shutoff up to the full pressure rating.
- A. All valves shall be hydrostatically pressure tested at 175 psi by the manufacturer.
- B. All valves shall be 100% full port design.
- C. All valves shall be provided with gear actuators and either handwheels or chainwheels, depending upon the mounting height. All valves mounted at six (6) feet or higher above the floor shall be provided with gear actuators and chainwheels. All gear actuators shall be provided with an indicator plate, which shall indicate valve position throughout the operating range. An adjustable stop shall be provided to provide field adjustment of closure.
- D. Where indicated on the Contract Drawings or requested by the Engineer, plug valves shall be furnished with bevel gear nut actuators for use with a hand-held electric driver specified elsewhere.
- E. Where indicated on the Contract Drawings or requested by the Engineer, plug valves shall include a valve stem extension constructed of painted steel. Valve stem extensions shall be of the length required as indicated on the Contract Drawings. Intermediate valve supports and hardware required for mounting of the extension shall be provided by the installing contractor. Valve stem extensions shall be suitable for use with the valve actuators specified herein.
- F. Plug valves shall be as manufactured by DeZurik Water Controls, Sartell, MN; Clow

Valve Company, Oskaloosa, IA, Kennedy Valve, Elmira, NY, or approved equal.

2.12 HANGERS AND SUPPORTS

- A. The Contractor shall furnish and install all supporting devices necessary or required to support all valves and appurtenances in a safe, firm and substantial manner at the locations indicated or as required in a manner to prevent the loads of valves and appurtenances from being carried on pumps, pipes or other equipment.
- B. Plug valves in horizontal pipelines shall be installed with shaft in horizontal position so that with valve in open position the plug is located in the upper part of the valve body. The valves shall be oriented so that with valve in closed position; the plug is at the upstream end of the valve.
- C. Install hangers and supporting devices necessary or required to hold all valves and appurtenances in a safe, firm and substantial manner at the positions indicated or as required and in a manner to prevent the loads of valves and appurtenances from being carried on pumps or other equipment.

2.16 COMBINATION AIR RELEASE VACUUM RELEASE VALVES FOR PUMP DISCHARGES:

- A. Combination air release/vacuum release valves shall be equipped with both a large orifice and a small orifice within a single body. The combination air release/vacuum release valve shall be specially designed to operate with liquids carrying solid particles such as wastewater and effluent. The combination air release/vacuum release valves shall discharge air during the filling or charging of the system, admit air to the system while draining and at water column separation and discharge accumulated air from the system while operating under pressure.
- B. All pumping equipment (excluding sump pumps) shall be equipped with a combination air release/vacuum release valve on the pump discharge in non-submerged locations (i.e. wet wells). The location of the valves shall be as recommended by the manufacturer. The manufacturer shall specifically design all combination air release/vacuum release valves for the proposed application. Combination air release/vacuum release valves shall weigh no more than 40 pounds each and shall be manufactured of steel plate, stainless steel or reinforced nylon material. Combination air release/vacuum release valves of cast iron valve construction shall not be acceptable. Combination air release/vacuum release valves shall include a rolling seal air release system made of non-corrosive plastics. Valves shall be equipped with conical shaped bodies equipped with an aerodynamic float and body. Combination air release/vacuum release valve shall be spring loaded to allow for ½-inch play in the float closure so that the float closure absorbs major turbulence during operation. Valves shall have a minimum guaranteed working pressure range of 3 to 250 psi and normal working temperature of up to 140°F with a maximum instantaneous working temperature of up to 190°F.
- C. Combination air release/vacuum release valves shall be as manufactured by A.R.I. USA, Inc.; G.L. Lyons or approved equal.

2.17 VALVE IDENTIFICATION:

- A. Provide stainless steel identification tags for each valve supplied. Markings on tags shall be stamped with letters at least ¼-inch high, spelled out in full.
- B. Provide a valve schedule that identifies all valves installed under this project. Schedule shall include valve size, type, location, and process stream. Valve schedule shall be submitted to Engineer for approval.
- C. The Contractor shall provide and hang in the operations office a typewritten, framed and glass covered valve chart indicating the number and location of the valves and the area served.

2.18 PRESSURE GAUGE ASSEMBLIES:

- A. Pressure gauge assemblies to be supplied by pump manufacturer per specification section 33 32 13.

2.19 SHOP PAINTING:

- A. Before exposure to the weather and after thorough cleaning to remove all rust, dirt, grease and other foreign matter, the valves, floorstands, and appurtenances shall be painted in the shop as specified below.
- B. Ferrous surfaces which will be submerged shall be cleaned by sandblasting to remove all foreign matter.
- C. Interior surfaces of all valves, the exterior surfaces of buried or submerged valves and gates, and miscellaneous piping appurtenances shall be given a shop finish of an asphalt varnish conforming to Federal Specification TT-V-51c, for Varnish, Asphalt.
- D. After thorough cleaning, exterior surfaces of various parts of valves and miscellaneous piping appurtenances exposed within the building shall be given one shop coat of an approved rust-inhibitive primer compatible with the field coats and applied in accordance with the instructions of the paint manufacturer.
- E. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

PART 3 - EXECUTION

3.01 INSTALLATION:

All valves shall be carefully erected and supported in their respective positions free from all distortion and strain. Care shall be taken to prevent damage or injury to the valves or appurtenances during handling and installation. All material shall be carefully inspected for defects in workmanship and materials, all debris and foreign material cleaned out of valve openings and seats, all operating mechanisms operated to check their proper

functioning, and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.

3.02 FIELD PAINTING:

Field painting of valves shall be in accordance with Section 09 90 00, PAINTING.

END OF SECTION

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SECTION 40 06 21

PIPE AND EQUIPMENT SUPPORT SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section covers the design, fabrication and installation of all pipe and equipment support systems appurtenances and incidentals as shown on the Drawings and specified herein.
- B. The Contractor shall furnish all labor, materials, tools and equipment necessary to fabricate and install the pipe and equipment support systems. The actual quantity and type of pipe and equipment support systems shall be as required by the pipe and equipment support system design engineer to provide adequate support while meeting the minimum design and factor of safety requirements noted herein.

1.02 RELATED WORK:

- A. DIVISION 11 – EQUIPMENT
- B. DIVISION 40 – PROCESS INTEGRATION

1.03 REFERENCES:

- A. International Building Code (IBC) and/or latest code adopted by the local building official, and all other applicable state, federal and local ordinances.
- B. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM	A500	Structural Tubing
ASTM	A53	Structural Pipe
ASTM	A36	Plates and Angles
ASTM	A992	Structural W Shapes
ASTM	A572	Structural S, M & H Shapes
ASTM	A123	Hot Dipped Galvanizing
ASTM	A240	Stainless Steel Plate, Sheet and Strip

ASTM A276 Stainless Steel Bars and Shapes

ASTM C177 Test Method for Steady - State Heat Flux Measurements and Thermal Transmission Properties by means of the Guarded-Hot-Plates

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer literature and shop drawings of the materials of this section. Shop drawings shall include the materials of construction, support design loadings, factor of safety, location and dimension of each pipe/equipment support of all pipe/equipment supports.
- B. Design calculations shall be submitted for record purpose only. The calculations shall prove compliance with the requirements specified herein, shall show details and procedures of construction, and shall be live stamped by a registered Professional Engineer in the State of New Hampshire.
- C. Submittals shall include but are not limited:
 - 1. Detailed layout drawings including all plan and elevation views for the supports.

1.05 QUALITY ASSURANCE:

- A. The pipe and equipment support systems manufacturer shall have a minimum of ten (10) years successful experience in the design and assembly of pipe support systems.
- B. Pipe and equipment support systems shall be as manufactured by SAC Incorporated, Williston, VT; or approved equal.

1.06 GUARANTEE:

The pipe and equipment support systems manufacturer shall guarantee all piping and equipment support structures against defective materials or workmanship for a period of 20-years after the date of Substantial Completion. If any material or workmanship proves to be defective within ten years, they shall be replaced or repaired by the piping and equipment system manufacturer at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Design Loadings

The pipe and equipment support systems shall be designed such that the support can support its own weight, the media within the pipe/equipment, plus the following minimum superimposed loads:

- I. Applied Live Loadings: 150 lbs./sf minimum
- II. Seismic Loadings:
 - a. Seismic Design Category: Site Specific (coordinate with local requirements)
 - b. Seismic Importance Factor: 1.25 minimum
 - c. Component Importance Factor: 1.50 minimum
 - d. MCE Spectral Response (S_s): 0.22 g minimum
 - e. MCE Spectral Response (S_i): 0.06 g minimum
 - f. Soil Site Class: Site Specific (coordinate with local requirements)
- III. Wind Loadings:
 - a. 3 Second Gust Wind Speed: 125 MPH minimum
 - b. Exposure Type: C
 - c. Importance Factor: 1.20 minimum
- IV. Applied Snow Loadings: 50 lbs./sf minimum

B. All supports, hardware, hangers, adhesives, anchors and appurtenances for the piping support systems shall be designed with a minimum 2.0 factor of safety on top of the design loadings noted above.

C. All tube style supports shall have a minimum diameter of 1-inch and shall be mounted to a minimum 4-inch by 6-inch by 1/4-inch thick mounting base plate. All mounting baseplates shall be mounted on a minimum 1-inch thick non-shrink grout and have a minimum embedment of 2-inches.

D. These specifications direct attention to certain features but do not purport to cover all

details of the design of the supports. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness, and to be especially adapted for the work done.

2.02 SUPPORT MATERIAL CLASSIFICATIONS:

A. All support materials and appurtenances shall meet the following requirements.

- a. Wet and/or Corrosive areas: Type 316 Stainless Steel or equivalent based on materials compatibility (to be coordinated by the piping support system designer).
- b. Chemical Storage/Feed areas: Type 316 Stainless Steel or equivalent based on materials compatibility (to be coordinated by the piping support system designer).
- c. Pumping Stations Valve Area: Type 316 Stainless Steel.
- d. Pumping Stations Wetwell: Type 316 Stainless Steel or equivalent based on materials compatibility (to be coordinated by the piping support system designer).
- e. Explosive Areas: Type 316 Stainless Steel or equivalent based on materials compatibility (to be coordinated by the piping support system designer).
- f. Dry Areas: Hot Dipped Galvanized
- g. Exterior Areas within 10 feet of Wet and Corrosive Areas:
Type 316 Stainless Steel or equivalent based on materials compatibility (to be coordinated by the piping support system designer).
- h. Exterior Areas beyond 10 feet of Wet and Corrosive Areas:
Hot Dipped Galvanized

2.03 HANGERS AND SUPPORTS:

B. The Contractor shall furnish and install all supporting devices necessary or required to support all equipment, piping, valves and appurtenances in a safe, firm and substantial manner at the locations indicated on the drawings or as required. The actual quantity of

the supports shall be as necessary to meet the design requirements specified herein and as determined by the pipe and equipment support systems design engineer. The pipe and equipment support systems shall be provided in a manner to prevent the loads of equipment, piping, valves and appurtenances from being carried on pumps, pipes or other equipment.

- C. Isolation valves in horizontal pipelines shall be installed with shaft in horizontal position so that with valve in open position the isolation mechanism (plug for plug valves) is in the upper part of the valve body. The valves shall be oriented so that with valve in closed position; the isolation mechanism (plug for plug valves) shall be at the upstream end of the valve.
- D. Install hangers and supporting devices as necessary or required to hold all equipment, piping, valves and appurtenances in a safe, firm and substantial manner at the positions indicated or as required and in a manner to prevent the loads of equipment, piping, valves and appurtenances from being carried on pumps, pipes or other equipment.
- E. All floor mounted pipe supports for flanged piping shall be flanged type adjustable pipe supports with an expansion pipe length as required but with a minimum adjustment length of 4-inches.

2.04 ANCHORS:

A. Adhesive Anchors

- a. Hot Dipped Galvanized: Minimum F1554 Grade 36
- b. Stainless Steel: Minimum Grade 316
- c. Epoxy: Minimum equivalent to Simpson Set-XP High Strength Epoxy

B. Expansion Anchors

- a. Simpson Strong Tie – Strong Bolt: Zinc Coated Per ICC ESR-3037
- b. Hilti – Kwik Bolt TZ: Type 316 Stainless Steel

C. Provide anti seizing lubricant on all support system threads.

2.05 FABRICATION:

- A. Fabricate all work true to dimensions, square, plumb, level and free from distortion or defects detrimental to appearance and performance.
- B. Grind off and smooth all surplus welding materials.

- C. Welding shall be in accordance with the AWS Structural Welding Code, latest edition.
- D. All stanchions and/or enclosed supports shall have minimum ¼-inch weep holes provided to allow for the release of gas due to welding.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. The Contractor shall verify all conditions, dimensions, slopes and elevations prior to installation of the pipe and equipment support systems.
- B. The Contractor shall provide temporary shoring/bracing as required. Shoring shall support all loads to which the structure may be subjected to (wind, snow, live, etc.). Shoring shall remain in place as long as required for safety or until all the structural support elements have been completed.
- C. All equipment, piping, valves and appurtenances support systems shall be carefully erected and supported in their respective positions free from all distortion and strain. Care shall be taken to prevent damage or injury to the equipment, piping, valves and appurtenances during handling and installation. All material shall be carefully inspected for defects in workmanship and materials, all debris and foreign material cleaned out, all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Piping support systems which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.

3.02 FIELD PAINTING:

Field painting of equipment, piping and valves shall be in accordance with Section 09 90 00, PAINTING. Unless otherwise noted pipe support systems shall not be painted. However, the location where the pipe support attaches to the equipment, piping and valves shall be painted. The pipe support systems shall be removed and re-installed as necessary for piping painting at no additional cost to the Owner.

END OF SECTION

SECTION 40 91 00

FIELD INSTRUMENTS AND EQUIPMENT

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK:

- A. Supply field instruments and equipment as shown on the Drawings and indicated herein. Calibrate, configure, test, and start-up instrumentation.

1. Instrumentation and Controls Supplier:

- a. The Contractor's attention is directed to the fact that the instrumentation and controls are an integrated system and as such, shall be furnished by one supplier, who shall provide all of the equipment and appurtenances regardless of manufacture, and be responsible to the Contractor for satisfactory operation of the entire system. Substitutions on functions specified will not be acceptable.
- b. The Owner's System Integrator is Wilson Controls, LLC, Lee, NH. The System Integrator shall configure communications between the new PLC/Control Panel and the Owner's existing SCADA system network and shall configure the Owner's existing SCADA system for proper monitoring and control of the new pump station provided in this Contract. The Contractor shall coordinate, schedule and pay for System Integrator to configure communications between the Control Panel and Owner's existing SCADA system.

1.02 SUBMITTALS TO THE ENGINEER:

In accordance with Sections 01 33 23.

1.03 TESTING AND START-UP:

In accordance with Section 01 75 00.

1.04 WARRANTY:

- A. All Instrumentation shall be warranted for one year from final acceptance of the system. The warranty shall include the immediate (within 24 hours) response to emergency calls affecting treatment plant operations including problems and questions regarding equipment, software, and programming.
- B. Warranty shall be in accordance with Divisions 01, 40 and 46.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. All of the equipment shall be the manufacturer's latest proven design. Specifications and drawings call attention to certain features, but do not purport to cover all details entering into the design of the instrumentation system. The completed system and the equipment furnished by the Contractor shall be compatible with the functions required.
- B. Components shall be finished to the manufacturer's standard for the service intended unless otherwise indicated in the specifications or on the drawings.
- C. All electrical components of the system shall operate on 120-volt, single-phase, 60-Hertz current, or 24vdc except as otherwise noted in the specifications.
- D. All controls for electrically operated or motor-driven equipment shall be completed, including all necessary auxiliary relays, so as to require only wiring and connections to the equipment control circuit. All contacts for control of motor-operated or electrically operated equipment shall be rated not less than 10 amperes on 120 volts unless otherwise specified herein.
- E. All motor-operated or electrically operated equipment shall have separate 120-volt power and control circuits, and optionally 208v 3 phase, 120v 1 phase, and 480v 3 phase, as required.
- F. Control wiring for externally operated motors shall be No. 12 AWG, minimum and in accordance with Division 16.
- G. All necessary fuses or switches required by the instrumentation manufacturer for his equipment shall be provided with the equipment. All instruments requiring an external power supply shall have a labeled ON-OFF switch.
- H. Provide all required piping, connections, hangers, supports, etc. required for the Instrumentation and equipment, unless specified to be provided by Others.
- I. The Drawings and Specifications indicate the energy sources that will be provided. Any other devices necessary to obtain proper operation of the instrument system from these energy sources shall be furnished with the instrumentation.
- J. Instrumentation equipment supplier shall provide and install all instrument cable as needed between instrumentation system equipment components, unless otherwise indicated.
- K. Nameplates shall be attached to all field-installed units.
- L. All field-mounted instrumentation utilizing 4-20 mA signals shall be furnished with an appropriately sized local surge arrester at each end of the line. The surge arrester shall

be adequate for the intended function and shall be by a nationally recognized manufacturer with a minimum of 3-years' experience in the manufacturer of such devices. Submit selected model and backup information for review and acceptance by the Engineer. Surge arrestor shall be manufactured by Transtector, Phoenix Contact, or equal.

- M. Instrumentation shall be installed per instrumentation construction standards and details, manufacturers recommended practices in accordance with the mechanical and electrical drawings and specifications. Instrumentation shall be suitable for the application and the environment. Equipment shall be pre-calibrated. Provide all field calibration as required to verify correct operation. Review calibration ranges during shop drawing submittal with Engineer. All instrumentation shall be factory calibrated, bench checked, and field calibrated in accordance with ISA Standards and Practices. Equipment shall be suitable for use with the process fluid, when applicable.

2.02 FLOW MEASURING DEVICES (FE/FIT):

B. Magnetic Flow Element (FE) and Flow Indicating Transmitter (FIT)

1. Provide magnetic tube type flow meter and transmitter as indicated on the Drawings and herein specified. The flow meters will be hardwired to the indicator, and the isolated PLC.
2. Completely obstruction-less design with stainless steel or Hastelloy C4 electrodes and electrode access ports. Furnish with grounding rings.
3. Internal power source
4. Constructed of non-magnetic steel (316ss/Hastelloy) with class 150 ANSI flange connections. Provide unit with PTFE or hard rubber liner suitable for use with wastewater.
5. Enclosure shall be NEMA 4X rated, paint finish and corrosion resistant. Enclosure shall be IP68 rated for continuous submergence.
6. Accuracy of plus or minus 1% of actual flow.
7. The flow transmitter shall be remote located. Unit shall display flow rate and flow total.
8. The signal converter or indicating transmitter [LED local indicator] furnished with an indicator shall be calibrated to read in gpm, range as required by the Engineer.
9. The transmitter output shall be converted to a 4-20 mA flow rate signal. The 4-20mA signal shall be sent to the PLC in the equipment control panel.

10. Water Flow Display/Totalizer

- a. The display/totalizer signal shall go to the PLC. The PLC shall be actuated by 4-20 mA/DC signal.
- b. The totalizer signal, complete with flow integrator, shall be actuated by the 4-20 mA input signal proportional to square root of pressure differential and through a math counter and timer provide total flow data. The PLC shall indicate flow as "hundreds of gallons" or " x 100 GAL".
- c. The display/totalizer shall be provided with a dry contact which closes with flow.

11. Magnetic flow meter and indicator shall be manufactured by Krohne, Siemens, or ABB.

12. Provide transmitter according to the following criteria:

- a. Instrument to measure a pressure differential to be coordinated with the flow tube primary as specified under this section and as described in Functional Descriptions.
- b. Output signal to be 4 to 20 mA dc linear with flow.
- c. Transmitter 4 to 20 mA dc output to be fully adjustable over a 15:1 range.
- d. Adjustment of zero setting to be possible without removing instrument cover.
- e. Instrument wetted parts to be constructed of Type 316 stainless steel.
- f. Transmitter mechanism to be protected by a gasketed or weatherproofed enclosure providing a NEMA 4X level of environmental protection.
- g. Sensor elements to be a cobalt-nickel chrome alloy.
- h. Transmitters to be pipe stand mounted from wall or process piping.
- i. Transmitter to be designed for a working pressure of 2000 psi and a maximum ambient temperature of 180°F.
- j. A three valve manifold with test pipe is to be provided and mounted on the flow transmitter.
- k. Accuracy +0.2 percent of calibrated span. Drift (over 6-month period) less than 0.1 percent of upper range limit.

2.03 LEVEL MEASURING DEVICES:

A. Submersible Level Sensor/Transducer (LE/LT)

1. The level control system shall be a looped power sealed submersible level transmitter, complete with lightning protection at each end. The level transmitters will be hardwired to panel indicators, alarm module, and the isolated PLC.
2. The transducer shall be pre-calibrated.
3. The sensor shall be equipped with adjustable zero and span.
4. The sensor shall have fixed barometric compensation [no breather].
5. The transducer shall be passive powered from external 24 VDC, 4 to 20 mA DC power supply in control panel [suitable for 1000 feet length 2c#16TWS, provide calculation for power supply].
6. The transducer shall be mounted with a standoff support anchor and piping 316ss construction throughout.
7. Cable sealed as required feet length by vendor
8. Provide lightning protection at field junction box and at main control panel by Transtector. Verify installation depth prior to ordering calibration level transmitter with appropriate cable lengths.
9. The transducer shall be manufactured by Kpsi with lifetime lightning protection; or equal.

B. Level Float Switch (FS)

1. Provide float switches according to the following criteria:
 - a. Non-mercury switch type liquid level displacement sensor.
 - b. Non-oxidizing Form C contacts to allow low DC voltage signals for use with intrinsic safety devices.
 - c. Provide a stainless-steel mounting rack with an adjustable cable stop for each float switch.
 - d. Equipped with 30 feet (min.) of PVC chain with cast iron weight.
 - e. Electrical cable length as require for each level switch with 24 inches for future field adjustment.

2. Float switches shall be Model CFS by Dywer Instruments, Inc., Michigan City, IN, Model LS-10 by Gems, or approved equal.

2.04 DOOR CONTACTS:

- A. Provide magnetic type door contacts for surface mounting with magnet actuated contacts, equal to GE Sentrol 1045T, Tane SM20, or equal.

2.05 TEMPERATURE DEVICES:

- A. Temperature Transmitter (TT)
 1. Provide a room temperature 100-ohm platinum RTD sensor and transmitter assembly with display. The device shall be loop powered and output a 4 to 20 mA DC signal proportional to measured temperature (0 to 100 °F). The display shall be 3-1/2 Digit LED with red characters.
 2. Temperature transmitter shall be DEVAR Inc. Model RTTI or equal.

2.06 INSTRUMENT WIRING REQUIREMENTS:

- A. All control wiring (120 or 24 volt, AC or DC) conductors shall be insulated for 600 volts, unless otherwise noted, and shall be No. 14 AWG minimum size, or larger if so indicated on the Drawings. Conductors shall be 98 percent copper, stranded, heat and moisture resistant and thermal plastic insulated. Acceptable Manufacturers: Okonite, Southwire, Pirelli.
- B. All instrumentation control cables (4-20 mA signal) referred to on the Drawings as "twisted shielded pairs", shall be individually shielded twisted pairs, No. 16 AWG, stranded conductors of tinned copper with polyethylene insulation and aluminum - polyester shielding. Control cable shall be rated 600 volt and shall be UL listed with 100% shield coverage. Belden or equal.
- C. RTD wiring shall be 600V triads 3C#16TWS with stranded copper drain wires, material to match the characteristics of the specific RTD.
- D. Three conductor shielded cable for use with remote potentiometers for varying motor speeds etc. Cable shall be polyethylene insulated, No.16 AWG stranded conductors cabled with BELDFOIL aluminum-polyester shield, 18 AWG stranded tinned copper drain wire and chrome vinyl jacket. Cable 600V shall have 100% shield coverage and shall be Belden or equal.
- E. Non-metallic sheathed cable (600 Volt), type NM and NMC/UF, shall have copper conductors as specified in this section. Cables shall conform to U.L. Standard 719, Federal Specification J-C-30A and Article 336 of the National Electrical Code. Acceptable Manufacturers: Southwire, U.S. Wire & Cable, or equivalent.

2.07 SPARE PARTS AND TEST EQUIPMENT:

- A. The Contractor shall provide the manufacturer's standard spare parts kit, with each part packed in a container and labeled.

PART 3 - EXECUTION

3.01 GENERAL:

- A. All instrumentation shall be installed in accordance with state and local building and electrical codes, general instrumentation practices, and manufacturer's requirements. All equipment shall be fully tested and calibrated. All instrumentation shall operate in accordance with the design intent. Provide documented record drawings. The Engineer shall review all instrumentation and controls at the time of startup, and all corrections made by the Contractor as required.
- B. The ranges and field connections shall be verified by the Engineer and instrumentation system integrator during the submittal process.
- C. The Contractor shall plan and execute the installation so that the facility will be able to meet its discharge permit at all times. Submit a plan prior to construction.

3.02 START-UP AND TESTING:

- A. In accordance with Specification Divisions 01, 33, and 40.
- B. A start-up checklist and procedure for the Instrumentation shall be prepared and submitted to the Engineer for approval prior to final start-up.
- C. Operator training shall be provided for a minimum of five, 8-hour days (not including travel time) for the overall instrumentation and control system. Two days of training after system acceptance by the Engineer, two additional days of training after system has been in service for three months and one day of training after system has been in service for nine months.
- D. The system integrator shall provide complete documentation for all systems prior to Owner/Engineer witness testing.

END OF SECTION

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SECTION 40 95 13

CONTROL PANELS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. Fabricate pump station control panel as described herein and integrate into the Owner's SCADA system. All new panel components shall be furnished and installed in accordance with these specifications and applicable standards and codes.
 - 1. Instrumentation and Controls Supplier:
 - a. The Contractor's attention is directed to the fact that the instrumentation and controls are an integrated system and as such, shall be furnished by one supplier, who shall provide all of the equipment and appurtenances regardless of manufacture, and be responsible to the Contractor for satisfactory operation of the entire system. Substitutions on functions specified will not be acceptable.
 - b. The Owner's System Integrator is Wilson Controls, LLC, Lee, NH. The System Integrator shall configure communications between the new PLC/Control Panel and the Owner's existing SCADA system network and shall configure the Owner's existing SCADA system for proper monitoring and control of the new pump station provided in this Contract. The Contractor shall coordinate, schedule and pay for System Integrator to configure communications between the Control Panel and Owner's existing SCADA system.
- B. All systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment, and materials required to provide complete, properly functioning systems.
- C. Refer to Electrical and Mechanical Drawings to coordinate material and equipment locations.
- D. Work Included
 - 1. Furnish, install, configure, and program instrumentation and control systems as described and specified herein and as shown on the Contract Drawings. Provide connection to control, status indication, and alarm annunciation equipment as described herein.
 - 2. Provide a new Pump Station Control Panel (MCP).

3. Coordinate with the manufacturers of supplied equipment for specific instrumentation and control requirements. Installation and wiring of instrumentation shall be in accordance with the manufacturer's recommendations.
4. Any deviation in instrumentation or electrical materials or methods caused by requirements of the supplied equipment will be provided at no additional cost to the OWNER.
5. Furnish and install all transducers, converters, terminals, transformers, interposing or pilot relays (for both new and existing equipment), signal transmitters, signal splitters/boosters, uninterruptible power supplies, power supply connections and other miscellaneous instrumentation required to make a complete system.
6. Furnish analog signal conditioning isolators between field instruments and control panels to protect analog signals from noise, surges, and ground loops.
7. Furnish and install all vendor or manufacturer cables and appurtenances between primary instruments and the transmitters, receiving instruments or destination terminals. All methods, materials and supplies will meet the requirements of Division 26, Division 33, and Division 40.
8. The General Contractor shall furnish and install all sleeves, bolts, inserts, equipment mounting hardware and other items to be attached to or imbedded in concrete and masonry work.
9. Provide start-up, testing and training for the entire instrumentation and control system including all new instruments and control panels.
10. Upon completion of the project, the Instrumentation System Supplier shall provide one separate 8-hour working day on-site (not including travel time) to be used upon demand of the Owner within the first year's operation. This time shall be used for service calls (not related to warranty or deficiencies in the Contract work), modifications to programming and software configuration.

C. Related Work Specified Elsewhere

1. Section 33 32 13 – Self-Priming Wastewater Pumping Equipment
2. Section 40 91 00 – Field Instruments and Equipment
3. Electrical – Division 26.

D. Related Work by Others

1. Instrumentation signal conduit and wiring, and power conduit and power wiring between panels and remote devices are furnished and installed by electrical subcontractor. The electrical contractor shall mount and power the control panels.

E. Demonstration and final Engineer-witnessed testing

1. The Owner will assume no liability or responsibility for any portions of the installation under this Contract until they are demonstrated and accepted in writing. Final demonstrations shall be made only after the Engineer is satisfied that the work has been completed in accordance with the intent of the Contract Documents.
2. After the Instrumentation and Control System is completed, the Contractor shall request that the Engineer witness a demonstration of the total system operation. If any system or piece of equipment within a system fails to function properly, rectify such defects or inadequacies, and make a final demonstration.
3. All demonstrations shall be scheduled at the convenience of the Engineer and the Owner and shall be scheduled with at least five (5) days written notice.

1.02 QUALITY ASSURANCE:

- A. Owner's standard instrumentation, controls, and SCADA equipment and components shall take precedence over the equipment and components specified in this section (40 95 13) and section 40 91 00.
- B. All materials provided under this Contract shall be equal in quality, appearance, and performance to that specified herein and shall be subject to the approval of the Engineer. Verify the availability of all materials proposed to be used in the execution of the work prior to submitting same for the Engineer's approval. The discontinuance of production of any material or product after approval has been granted shall not relieve the Contractor from furnishing an Engineer approved alternate of comparable quality and design without additional cost.
- C. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.
- D. The Contractor shall have supplied comparable systems to those specified herein and shall maintain engineering and service departments capable of designing and

maintaining these systems. Provide, for a period of twelve (12) months from the date of final acceptance of the work, all necessary supervision, labor, materials, and equipment, in order to correct any defects in any system due to faulty materials, equipment, installation methods, or workmanship and consequent damage resulting from such defects. This work shall be scheduled during normal working hours and at the convenience of the Owner.

E. Programming standards

1. In addition to creating and maintaining wiring diagrams, I/O schedules and PLC database mapping, the Integrator shall document all work within software programming files.
2. Documentation shall include, but not be limited to rung titles which clearly indicate function; comments for each rung used with references to paper documents; and symbolic addressing of PLC registers.
3. Integrators shall use Contract Documents tag names for instrumentation and equipment PLC symbol addressing when provided on the Drawings and in the Specifications.
4. The PLC programming code and OIT software configuration shall be considered electronic records of the work performed. All changes made in the programming shall be documented electronically with date, integrator name, and description of change.

1.03 SUBMITTALS TO THE ENGINEER

A. Shop Drawings and Samples

1. Submit Shop Drawings in accordance with Section 01 33 23 and as indicated herein.
2. Shop Drawings shall be thoroughly checked by the Contractor for compliance with the Contract Documents. Verify that all equipment and materials proposed to be furnished will fit into available space and maintain specified clearances, and that all equipment is compatible with the system operation. Provide complete equipment panel layout drawings, equipment catalog cuts, schematic wiring diagrams, point to point wiring diagrams for all systems inputting to the PLC system.
3. Shop Drawings Shall Consist of:
 - a. Project name and location.
 - b. Contractor's name and contact information.

- c. Instrumentation System Supplier name and contact information.
 - d. Index Sheet - Listing the equipment being submitted using equipment designations, tag identification, and/or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/type, and catalog number.
 - e. Manufacturer's scale or dimensioned drawings along with standard catalog number.
 - f. Drawings of panel layouts including interior and exterior components keyed to a bill of materials.
 - g. Wiring diagrams shall be provided showing the interfacing between field hardware and PLCs, including network switches.
 - h. Electrical ladder logic drawings which shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.
4. All instrumentation and hardware shall be contained in one submission. The OIT graphical screens and PLC programming may be submitted after approval of hardware and software selections.
 5. Submissions shall be in the form of individual binders, of the quantity indicated in the General Conditions. Each equipment type shall be separated by index tabs with typewritten titles.
 6. Provide samples of instruments, devices, graphics, etc., within ten (10) days upon receipt of request from the Engineer.
- B. Maintain properly documented and witnessed test and checkout reports, described in Section 1.01 E and 3.02, and submit these to the Engineer. Test reports should indicate each control panel component tested and checked, with initials or signature, and listing of any problems encountered. Each new or modified I/O point should be tested in the field from instrument through to the PLC and OIT software. Provide the following submittals described in Section 3.02:
1. Start-up checklist and procedure
 2. Factory test reports and panel certifications
 3. Contractor testing and checkout reports
 4. Final start-up schedule and request for Engineer witnessed testing

- C. Upon completion of the work and before request for final payment, deliver to the Engineer five (5) bound sets of full and complete directions pertaining to the operation and maintenance of all equipment and systems installed under this Contract. These directions shall be typewritten on 8-1/2" x 11" sheets neatly bound with index tabs, and shall be accompanied by plans, diagrams, etc., of the work installed, parts lists, etc., necessary for the guidance of the Owner in operating, altering or repairing the installation. Operational descriptions should include custom functional descriptions of the controller programming, list of hard-coded timers and set points, list of user-settable timers, control set points, alarm set points, and description of enable/disable functions. The descriptions should describe how to operate in automatic and manual, where applicable.
- D. Provide the Owner with a list of local service departments of duly authorized distributors of materials and equipment of the type installed, which will stock the manufacturer's standard parts, etc.
- E. At the completion of the installation, provide reproducible Record Drawings electronically on computer disk, accessible in AutoCAD. Also provide five (5) printed sets of each full-size Drawing indicating the final configuration of all systems as they were installed. Symbols, equipment designations, etc., shall be consistent with the Contract Documents. Provide exact locations of all work which has been concealed in concrete, masonry or underground. Submit two (2) sets of fully documented PLC programming for each controller printed and bound in 3-ring binders. Submit four (4) sets of documented programming on electronic disk. Final payment of at least 5% of the value of the work described herein will not be released until as-built drawings and documented programming has been received.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Coordinate material and equipment delivery with the project schedule. Notify the Engineer immediately, in writing, if material or equipment delivery will adversely affect the project schedule, include documentation from equipment suppliers indicating the revised delivery dates and the reason for the delay.
- B. Coordinate delivery of equipment directly to other vendors where instrumentation supplied under this section must be installed in panels supplied under other specification sections.
- C. Exercise care during loading, transporting, unloading, and handling of materials to prevent damage.
- D. Check for defective or damaged materials, and for incomplete equipment shipments within seven (7) days after equipment delivery to the project site.

- E. Store materials and equipment on the construction site in enclosures or under protective covering to assure that materials and equipment are kept undamaged, clean, and dry.
- F. Replace or repair, to the satisfaction of the Engineer, all materials and equipment that are defective or that have been damaged during installation, at no additional cost to the Owner.

1.05 WARRANTY:

- A. The entire Instrumentation and Control System, including programming shall be warranted for one year from substantial completion of the system, as defined in Division 1. The warranty shall include the immediate (within 24 hours) response to emergency calls affecting treatment plant operations including problems and questions regarding equipment, software, and programming.
- B. Warranty shall be in accordance with Division 1.

1.06 FUNCTIONAL DESCRIPTION AND EQUIPMENT:

A. General

1. The instrumentation functional descriptions provide a narrative of critical control functions and user display requirements. Any auxiliary devices such as lightning/surge protectors, relays, timers, signal isolators, signal converters etc. which are necessary to perform the functions specified and are not shown shall be provided as incidental to the project for reliable and secure operation of the instrumentation and control system.
2. Adjustments of the process variables, pump setpoints, pump on/off control or operating sequences for all pumps, valves, and related process shall be possible from the PLC via the local operator interface terminal.

B. Process Control System – General

1. All equipment will be able to be operated in Manual or Hand without the PLC operating. The pumps and equipment shall have local control stations or MCC/VFD mounted control stations for HOA, etc. Unless otherwise noted, the pumps and equipment shall be controlled by PLC and OIT in auto and virtual hand with status indicating and alarms lights.
2. All analog signals for process instrumentation shall be monitored for out-of-range or signal failure. When the signal input is below 4 mA, a signal failure alarm shall be annunciated.
3. A disagreement alarm shall be configured for each piece of equipment for which a running status feedback is provided. Configure the disagreement

alarm to annunciate when a pump or other equipment is called to run and no running status feedback is received within a set time delay, adjustable 0 to 60 seconds.

4. The Operator shall be able to enable/disable each alarm at the pump station control panel OIT.
5. Variable Frequency Drives shall be used as starters and shall not vary speed with wetwell level in order to maintain minimum required forcemain velocities.

C. Wet Well Level and Pumps

Wet well level is measured using one (1) submersible level transducer. A high-high level float switch in the wet well is used for pump backup level control (see description below).

The variable frequency drives (VFDs) for the two new pumps will have H/O/A selector switches that will allow automatic start/stop control of the pumps from the control system when in the "AUTO" position. Manual operation is performed by placing the selector switch in the "HAND" position. In "HAND" the pump speed will be controlled manually at the VFD. The VFD will provide a 4-20 mA signal to the PLC in proportion to the actual pump speed.

Automatic start/stop operations only and no speed control of the wet well pumps based on measured wet well level. At the OIT screen, operators will select the level signal, or average, for use in pump control. Pump control actions are as shown on mechanical drawings.

D. Pump Backup Level Control:

The pump backup level control system shall be capable of functioning during loss of utility power and/or PLC failure. Activation of the high-high level float switch shall trip a relay which shall automatically start the standby pump and run the pump for a pre-set duration, controlled by a timer. After the timer expires, the relay shall reset.

PART 2 – PRODUCTS

2.01 ELECTRICAL CONTROL COMPONENTS:

A. Panel Enclosure:

1. Control Panel materials and fabrication methods must conform to /underwriter Laboratories specification section UL 508A, and applicable referenced specifications noted therein. Pump control panel enclosure shall be constructed, in conformance with applicable section of National

Electrical Manufacturer's Association (NEMA) standards for Type 1 electrical enclosures. Enclosure shall be fabricated of steel having a minimum thickness of not less than 0.075-inch (14 gauge). All seams shall be continuously welded, and shall be free of burrs and voids. Interior and exterior surfaces shall be coated with a paint finish suitable for the NEMA classification of the enclosure. There shall be no holes through the external walls of the enclosure for mounting the enclosure or any components contained within the enclosure.

2. Provide all required connections, mounting accessories, supports, etc. required for the installation of the Control Panels, unless specified to be provided by Others. Panel enclosure up to 72" x 72" x 16" shall be mounted on floor stands and secured to pump base.
3. Enclosure shall be equipped with a door mounted on a continuous steel hinge and sealed around its perimeter. Door shall be held closed with clamps that are quick and easy to operate. The doors shall accommodate the mounting of switches and indicators.
4. Enclosure shall be furnished with removable back panel, fabricated of steel having a thickness of not less than 0.106-inch (12 gauge), which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.
5. The exterior and interior components of the control panel shall be "finger-safe" and free from the danger of electrical shock when in normal operating position. If a component required within the panel by these specifications cannot be made "finger-safe", obtain approval of its use from the Engineer and provide a clear warning label near the device.
6. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. All control devices and instruments shall be secured to the sub-plate with machine screws and lock washers. Mounting holes shall be drilled and tapped; Self tapping screws shall not be used to mount any components. All connections from the back panel to door mounted or remote devices shall be made through terminal blocks. All control devices shall be clearly labeled to indicate function.
7. All pump controls, interlocks, contacts, relays, power supplies and other miscellaneous equipment required to make a complete system in accordance with the intent of this section of the specifications shall be furnished and installed in the control panel. The components shall be industrial rated, heavy duty.
8. Uninterruptible Power Supply (UPS) shall be provided for the panel. The UPS shall be installed within the panel and may sit on the bottom of the

panel enclosure, however, the UPS shall not be located within 6-inches of any active components. The UPS shall not need to be moved to access other panel components. Provide panel enclosed Uninterrupted Power Supply (UPS), for 15 minutes at full load and 30 minutes at half load for all control panel components and connected devices.

9. All field-mounted instrumentation utilizing 4-20 mA signals shall be furnished with an appropriately sized local surge arrester at each end of the line. The surge arrester shall be adequate for the intended function and shall be by a nationally recognized manufacturer with a minimum of 3-years experience in the manufacturer of such devices. Submit selected model and backup information for review and acceptance by the Engineer. Surge arrester shall be manufactured by Transtector, Phoenix Contact, or equal.
10. Furnish analog signal conditioning isolators between field instruments and control panels to protect analog signals from noise, surges and ground loops.

B. UL Label Requirement

1. Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

C. Auxiliary Power Transformer

1. The lift station shall be equipped with a 9 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

D. Motor Branch Circuit Components

1. Main Connections
 - a. A main terminal block and ground lug shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with article 373 of the National Electric Code (NEC). A separate terminal strip shall be provided for

115 volt, single phase control power and shall be segregated from the main terminal block. Ten percent of the control terminals shall be furnished as spares.

- b. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.

2. Circuit Breakers and Operating Mechanisms

- a. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.
- b. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "off" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

E. Motor Starters

1. The variable frequency drive shall be capable of operation under any combination of the following conditions without mechanical or electrical damage.
 - a. Relative Humidity: Less than 95% non-condensing
 - b. Ambient Temperature: 0 to + 40 degrees C
 - c. Altitude: Less than 1,000M (3300 ft) above sea level
 - d. Vibration: .006 inches displacement, 1G peak
 - e. Shock: 15G peak for 11mS (+/- 1.0mS)
 - f. Control Specification
 - g. Control System: Sinusoidal pulse width modulated voltage waveform
 - h. Frequency Accuracy: +/- 0.4% of max. frequency

- i. Volts/Hertz Ratio: V/Hz user programmable
 - j. Operation Frequency: 0 to 60 Hz
 - k. Overload Capacity: 110% Overload capability for up to 1 minute, 150% Overload capability for up to 3 seconds
 - l. Variable frequency drives shall be Allen Bradley PowerFlex 753, or equal.
2. Digital Readout and Monitor
 - a. Interface to the drive is provided via a module with integral LCD display. Unit is a 7 line by 21 character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch. The unit will display standby status (power on, not running), output frequency (drive run), set-up parameters and fault. With keypad, user can monitor current, voltage, frequency, acceleration and deceleration time, minimum frequency and maximum frequency. Readout also provides inverter status and protective circuit status.
3. Protection
 - a. The variable speed drive system shall include a diode or fully gated bridge rectifier, capacitor filter, and transistorized inverter section. Base driver signals to control firing of the power transistors will be designed with optically coupled isolators for maximum protection of the control circuits from high voltage and noise. The output will be a sinusoidal, pulse width modulated, voltage waveform for reduced harmonic heating in the motor.
4. The system protection will provide the following:
 - a. Intermittent overload - 50 to 150%
 - b. Current limit - 50 to 115%
 - c. Overcurrent - 220-300% of rated output current
 - d. Inverse time overload - 50 to 100%
 - e. Short circuit - Phase to phase or phase to ground
 - f. Overvoltage - 10% above input line or DC bus voltage
 - g. Undervoltage - 10% below line voltage
 - h. Power loss ride-through - 500Ms

5. When the inverter trips out on a fault, the fault relay shall activate and the display shall indicate the reason for the trip as follows:
 - a. Overcurrent
 - b. Short circuit
 - c. Overload
 - d. Overvoltage
 - e. Undervoltage
 - f. Overheat
 - g. Ground fault
 - h. Motor stalled
 - i. Power supply fault
6. Auto restart shall occur when the inverter faults. Auto restart shall be adjustable up to 9 attempts with a 0.5 to 30 second interval. Auto restart will not be attempted for ground fault, output shorted, transistor shorted or internal microprocessor fault but will trip out immediately, activate the fault relay and make the appropriate indication on the display.
7. In the event of a fault trip, the microprocessor shall save the status of the inverter at the time of the fault and make that information available on the digital display. Information regarding the last 4 faults is maintained in event of a power loss.
8. Operational Functions:
 - a. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges).
 - b. Volts/Hertz patterns user selectable.
 - c. Maximum and minimum frequency limit adjustments.

F. Three Phase Voltage Monitor

1. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, high voltage, low voltage, and voltage unbalance. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.

G. Transient Voltage Surge Suppressor

1. All Control Panels shall have Surge Protective Devices installed immediately after the main overcurrent device or immediately after the supply conductors to the panel have been terminated. The Surge Protective Device(s) shall follow IEEE C62.41 recommendation for cascading to protect all voltage levels to and including 24 volts AC/DC and shall be as follows:
2. Be UL 1449 3rd Edition Recognized for UL Type 2 applications except at 48 volts AC/DC and below may be UL 1449 3rd Edition for Type 3 applications.
3. Provide suppression for both normal mode (L-N [Wye]) and common mode (L+N-G [Wye] or L-G [Delta]).
4. Have a Surge Current Capacity (I_{max}) of at least 40kA.
5. Have a Nominal Surge Current Rating (I_n) of 20kA.
6. Have SCCRs of 200kA, except that 347Y/600V, 240/480V High leg Delta and 347V single-phase SPDs shall have a minimum SCCR of 125kA.
7. Use MOV technology with thermal disconnect.
8. Be RoHS compliant.
9. SPD status monitoring shall be provided by local visual indication and, if needed, by remote contact signaling using an optional Form C contact relay.
10. Hardwired Listed Type 1 or Type 2 Surge Protective Devices Shall:
 - a. All Type 1 or Type 2 surge protective devices shall be manufactured by a single ISO-9001 registered company normally engaged in the design, development and manufacture of such devices for electrical distribution system/ equipment protection. Surge protective devices shall be UL Listed with a Short-Circuit Current Rating of 200kA, Nominal Discharge Current (I_n) of 20kA, and Surge Current Capacity (I_{max}) of 120kA, 200kA, 300kA or 400kA. These SPDs shall be installed in accordance with the NEC® and/or local code requirements. The said manufacturer shall offer a minimum five (5) year warranty for its Type 1 and Type 2 surge protective devices.
 - b. The hardwired surge protective device shall have specifications as shown below:
 - 1) The Maximum Continuous Operating Voltage (MCOV) shall not exceed 25% on Wye and 40% on Delta systems of the nominal voltage (system voltage) in the configuration being used

- 2) Prewired NEMA 1 or NEMA 4X factory sealed enclosure suitable for the intended installation location
 - 3) Shall have a two color LED status indicator per phase
 - 4) Have an operating temperature range of at least -40°C to +50°C
 - 5) Only use thermally protected MOV technology, such as Bussmann SurgePOD™.
- c. Surge Protective Device Agency Information: SPDs shall be "Listed" by Underwriters Laboratories, Inc. to UL 1449 3rd Edition as a Type 1 or Type 2 device and shall exhibit the UL Listing mark for the UL category VZCA for USA and/or VZCA2 for Canada; and must have CSA certification.
 - d. Manufacturers must provide verification of performance data for UL and CSA standards.
 - e. All SPDs must be RoHS compliant.
 - f. Surge protective devices shall be installed and located in accordance with all the applicable agency, NEC® and local code requirements. The SPDs must be suitable for the particular installation, be it on the upstream side (Type 1) or downstream side (Type 1 or Type 2) of service entrance Overcurrent Protective Device (OCPD).
 - g. All SPDs shall match voltage and system specific requirements as provided by the manufacturer.
 - h. All SPDs shall provide surge protection for both normal mode (L-N [Wye], L-L [Delta]) and common mode (L+N-G [Wye] or L-G [Delta]).
 - i. Surge protective device shall be clearly marked with specifications as required by UL 1449 3rd Edition along with UL holographic label on the SPD.
 - j. Each surge protective device should be serial numbered along with barcode for easy identification and traceability.

H. Voltage Alert Indication

1. The control panel shall include a voltage alert indicator to reduce the risk of electrical arc flash by pre-verifying the electrical isolation from outside of the control panel. Hardwired to the main incoming point of termination, the indicator shall be powered by the same voltage that it indicates utilizing redundant circuitry, thereby flashing whenever voltage is present. An eight detector display shall visually alert the presence of dangerous AC or DC potentials occurring between any combination of the monitored input lines.

I. Other Components

1. Furnish, install, program and test the controller, also called programmable logic controller (PLC) or programmable automation controllers (PAC), as described herein and in all applicable specification sections. The controller shall be programmed to meet the functional descriptions and general requirements detailed in this section.
2. The PLC shall be an Allen-Bradley CompactLogix 5370 L2 Control System. The PLC shall be equipped with a CPU with 750KB [1769-L16ER] or 1MB [1769-L18ERM] of user memory, and two EtherNet/IP communication ports supporting ring topologies and 1 USB port for firmware download and programming. The Controller shall utilize the small applications 1769 I/O modules. The Controller shall be designed to implement consumed tag, event instruction, embedded inputs, remote I/O, axis, and motion event triggers. The controller shall be equipped to handle up to 32 Controller Tasks and 100 programs/task.
3. The PLC shall operate on 24VDC power and be equipped with a 24VDC embedded power supply. A 1784-SD1 (1GB) Memory Module shall be shipped with the controller. The controller will contain, at least but not limited to, embedded digital I/O [16DC Inputs, 16DC Outputs]. The controller shall accept all digital and analog I/O necessary to accomplish the specified operation.
4. Provide PLC I/O modules required to connect signals listed in Attachment A of this section. Provide at least 25% spare I/O or one full spare module of each type of I/O for each control panel controller, which ever provides a greater number of spare I/O, unless otherwise specified.
5. The program logic shall be stored on the processor as well as on a programmable, read only 1 GB SD card [shipped with controller]. The memory module shall auto load and run when installed in the programmable control processor and is included to facilitate field repair or replacement of the programmable control hardware without the use of programming terminals or personal computers.
6. The controllers shall be equipped with all communications ports and cabling required to meet the functional descriptions and connect to equipment as shown on the Drawings and as specified herein.
7. The PLC shall communicate with the drive using an EtherNet/IP, but can also support other communication protocols such as ControlNet, or DeviceNet networks. The PLC shall issue drive start/stop and speed commands. Drive status shall also be communicated to the PLC using EtherNet/IP. The drive shall be configured to operate manually without the use of the PLC.

8. Provide the Owner with the original licensed software for each piece of hardware provided including the programming and communication software for the controllers, PLCs, and/or PACs.
9. An Allen-Bradley PanelView Plus 7 electronic operator interface shall be provided for data entry and display. The Operator Interface Display size will be at least 10 inches with Color active matrix, thin film transistor (TFT), liquid crystal display (LCD). The operator interface shall have an 18-Bit color graphic resolution with backlight CCFL of 50,000 hours minimum. The operator interface shall be mounted on the front of the control panel with other operator controls and shall be compatible with the PLC communication protocol. The operator interface shall be a backlit, touch-screen terminal. The operator interface program shall be stored externally on a Secure Digital (SD) card.
10. Electromechanical relays and timers, when used shall be equipped with 120vac coils and contacts rated NEMA A-300 minimum. Timers shall be pneumatic or synchronous motor driven.
11. The control circuit shall be fused, and shall be provided with a disconnect switch connected in such a manner as to allow control power to be disconnected from all control circuits.
12. Pump mode selector switches shall be connected to permit manual start and manual stop of each pump motor individually. Manual operation shall override shutdown systems supplied with the level control system except motor overload.
13. A pushbutton switch shall be provided to silence one of the 115 volt AC alarm circuits while corrective actions are underway. Depressing the alarm silence pushbutton shall also cause the high water alarm circuit (low water alarm optional) to reset when the liquid level has been lowered.
14. Pump alternation shall be integral to the PLC. Provisions for automatic alternation or manual selection shall also be integral to the PLC.
15. High Pump Temperature Shutdown Circuit
 - a. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to the PLC. If casing temperature rises to a level sufficient to cause damage, the thermostat N.O. contact shall close indicating a high pump temperature condition to the PLC. The PLC will then interrupt power to the pump motor. The operator interface terminal will display an alarm banner indicating the motor stopped due to high pump temperature. The motor shall remain locked

out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.

16. Elapsed Time Meter

- a. Six digit elapsed time meter shall be displayed on the operator interface terminal to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable and password protected.

17. Indicating Lights

- a. Indicating lights shall be provided on the Operator Interface Terminal to alert the user of the following conditions:

- 1) Pump Run
- 2) Pump Fault
- 3) Motor High Temperature
- 4) PLC Fail
- 5) Wet Well Level Alarm Conditions

- b. Physical indicating lights shall be oil tight type and equipped with integral step down transformers for long lamp life. Lamps shall be incandescent type rated 14 volts or less. Lamps shall be replaceable from the front without opening the control panel door and without the use of tools. Physical indicating lights will be provided for the following functions:

- 1) Normal Power Available
- 2) General Alarm

18. Switch Controls:

- a. Hand switches and push button switches shall be through-door flush mounted and sealed in accordance with respective equipment and Control Panel manufacturers recommendations.
- b. Individual NEMA 4 Hand-Off-Automatic selector switches shall be provided for each pump. The switches shall be 3-position rotary-type with spring return on the Hand position.

19. In general, provide the following components for the pump station control panel MCP:

- a. NEMA 1 enclosure, 72”H x 72”W x 16”D

- | | |
|--|--------|
| 2) AC control circuit less than line voltage | red |
| 3) Interlock control circuit, from external source | yellow |
| 4) Equipment grounding conductor | green |
| 5) Current carrying ground | white |
| 6) Hot with circuit breaker open | orange |

21. Wire Identification and Sizing

- a. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Wiring in conduit shall be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.
- b. Motor branch conductors and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the sub plate shall be bundled and tied. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit

22. Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

J. Conduit requirements are as follows:

1. All conduit and fittings shall be UL listed.
2. Liquid tight flexible metal conduit shall be constructed of a smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
3. Conduit shall be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
4. Conduit shall be sized according to the National Electric Code.

K. Grounding

1. The pump station manufacturer shall ground all electrical equipment to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.
2. The contractor shall provide an earth driven ground connection to the control panel at the main ground lug in accordance with the National Electric Code (NEC).

L. Equipment Marking

1. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - a. Equipment serial number
 - b. Control panel short circuit rating
 - c. Supply voltage, phase and frequency
 - d. Current rating of the minimum main conductor
 - e. Electrical wiring diagram number
 - f. Motor horsepower and full load current
 - g. Motor overload heater element (If applicable)
 - h. Motor circuit breaker trip current rating
 - i. Name and location of equipment manufacturer
2. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
3. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

M. Control logic shall be accomplished using programmable controllers. Electromechanical relays may be used when necessary. However, the primary control logic shall be performed by the PLC.

1. The O&M manual shall be provided with complete ladder logic program documentation including English names, rung comments, and coil/contact cross-references.
2. The control shall be pre-programmed or wired to provide the following routines:

- a. Pump alternation at lead stop
 - b. Excessive pump run time alternation
 - c. Jump to next pump on lead failure
 - d. Start/stop pumps at normal level settings (levels indicated on process mechanical drawings).
 - e. Pump start delays when called simultaneously
 - f. General alarm pilot light activation: Quick flashing alarm/slow flashing acknowledge/ steady on reset/off when clear
 - g. Station trouble alarm (115vac and normally open dry contact)
 - h. High and low-level alarms
 - i. Pump start/stop level control
 - j. Drive speed/level control
 - k. Pump high temperature shutdown
 - l. Drive fault alarm
3. All analog signals for process instrumentation shall be monitored for out-of-range or signal failure. When the signal input is below 4 mA or above 20 mA, a signal failure alarm shall be annunciated.
4. In addition to the alarms described elsewhere in this division, at a minimum, the PLC shall also collect the following internal and external I/O signals and relay the information to the OIT or as alarms:
- a. Utility Power Fail
 - b. Panel Power Fail
 - c. Building Door Switch/ Intrusion Alarm
 - d. Building Fire Alarm
 - e. Pump Station Low Temperature Alarm
 - f. Personnel Emergency
 - g. General Alarm
 - h. PLC Fail
- N. The operator interface shall be equipped with the following displays and functions:
- 1. Main Menu

2. Wet Well Level
3. Wet Well Level Simulation
4. Low Water Alarm Status
5. High Water Alarm Status
6. Pump High Temperature Status #1, #2
7. Drive Fault Status #1, #2
8. Pump Sequence Selection
9. Alarm Silence
10. Alarm Reset
11. General Alarm Lamp Test
12. Lead Level Start/Stop Setpoints
13. Lag Level Start/Stop Setpoints
14. Low Water Alarm Setpoints
15. High Water Alarm Setpoints
16. Speed/Level Setpoints 1 pump running
17. Speed/Level Setpoints 2 pumps running
18. Power-up Delay Setpoint
19. Alarm Delay Setpoint
20. Pump Start Delay Setpoint
21. Alternation Time Interval Setpoint
22. Level Transmitter Calibration
23. Flow meter signal readout
24. Flow totalization

2.02 LIQUID LEVEL CONTROL SYSTEM

- A. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. The pumps will each be equipped with a VFD to control the motor speed and start/stop the pump. Each VFD is equipped with local controls for manual operation as well as inputs and outputs for remote monitoring and control.

- C. H-O-A switches shall be provided for each pump to allow users to operate the pumps manually or select automatic control. In HAND, the pump shall start at the operator-adjustable pre-set start speed. The user shall be able to control the pump speed on the OIT. In the OFF position, the pump shall not operate and be taken out of the lead/lag alteration sequence. In the AUTO position, the pumps shall operate on an alternating lead/lag configuration as described herein with start and stop controls based upon wetwell level.
- D. Sequence of Operation with Utility Power
1. The level control system shall start and stop the pump motors in response to changes in wet well level. The level control system shall utilize the PLC sequencer to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle or if one pump runs as the lead pump for an excessive time.
 2. Level and speed controls shall include logical comparator setpoints. Settings shall be provided to control the levels at which the pumps start and stop as well as level endpoints for minimum and maximum speed. Two sets of speed setpoints shall be provided. The first set will be enabled when a single pump is running. The second set shall be enabled when two pumps are running. Each of the settings shall be adjustable and accessible to the operator without opening the control panel. Controls shall be provided to permit the operator to read and adjust the selected levels and speeds on the operator interface. Setpoint adjustments which require hard wiring, the use of electronic test equipment or artificial level simulation are not acceptable.
 3. Upon operator selection of automatic operation, the PLC shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the PLC shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the PLC shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating.
 4. When a single pump is running and the wet well is equal to the "1 pump minimum level", the drive will run at the "1 pump minimum speed". As the level rises, drive speed will increase to the "1 pump maximum speed" when the wet well level is equal to the "1 pump minimum level". Likewise, when two pumps are running, the "1 pump" settings will be disabled and the control will use the "2 pump" level and speed settings.
 5. Level control range shall be 0 to 12.0 feet of water. Speed control range shall be 20.0 to 60.0 hertz. Overall repeat accuracy shall be (plus/minus) 0.1 feet of water or hertz.

- E. Alarms and shutdown routines shall operate as follows:
1. Condition abnormal: The general alarm pilot light will quick flash until acknowledged, then slow flash until reset, then glow steady until condition returns to normal, then off. The operator interface will display the alarm when acknowledged. The external alarms will be active until silenced, and then off.
 1. Condition abnormal then returns to normal: The general alarm pilot light will quick flash until silenced, then slow flash until reset, then off. The operator interface will display the alarm when acknowledged. The external alarms will be active until silenced, and then off.
 2. Subsequent alarms will re-alarm when silenced or reset.
- F. Submersible Level/ Pressure Sensor (PT)
1. Submersible transducer will be furnished with transient voltage surge suppression to protect related equipment from an induced voltage spike from lighting.
 2. Provide lightning protection at field junction box and at main control panel. Verify installation depth prior to ordering calibration level transmitter with appropriate cable lengths.
 3. An intrinsically safe repeater shall be supplied in a separate enclosure. Repeater must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Electrical contractor shall make all connections from repeater to feeder lines and motor controls. Electrical contractor shall make connections from repeater to transducer.
 4. For wastewater applications, the transducer shall have a diaphragm for solids and be vented with aneroid bellows housed in a junction box prior to signal entry into the control panel.
 5. The transducer shall be in accordance with specification section 40 91 00.

2.03 STANDBY LEVEL CONTROL SYSTEM:

- A. Two (2) displacement or float switches shall be provided to automatically operate the pump in back-up mode, in case of failure of the submersible level transducer and PLC.
- B. Provide float switch according to the following criteria:
1. Non-mercury switch type liquid level displacement sensor.
 2. Suspended from a bracket by its own cable.

3. Vendor supplied instrument signal cable, length as required for each level switch application with 24 inches for future field adjustment.
4. In wetwells and open tanks, provide float chain and weight, cable strain relief and cable clips to secure the float location.
5. Float switches for use in wastewater process applications shall be rated for Class 1 Div 2 Group D hazardous location.

PART 3 - EXECUTION

3.01 GENERAL:

- A. All controls shall be installed in accordance with state and local building and electrical codes, general instrumentation practices, and manufacturer's requirements. All equipment shall be fully tested and calibrated. Provide documented record drawings. The Engineer shall review all instrumentation and controls at the time of startup, and all corrections made by Contractor as required.
- B. The ranges and field connections shall be verified by the Engineer and instrumentation system integrator during the submittal process.
- C. The control panels shall be completely factory assembled and tested. Do not ship the panel to the site until the Owner has approved the completed panel. The contractor shall provide all equipment from other divisions as required to make a complete system.

3.02 START-UP AND TESTING:

- A. In accordance with Specification Division 1.
- B. Start-up of individual control systems may be required prior to start-up of the overall control system and control system network. The Instrumentation Supplier shall integrate all individual sub-control systems into a site-wide complete system to achieve final start-up. A start-up checklist and procedure for the control system, PLC network and Instrumentation shall be prepared and submitted to the Engineer for approval prior to final start-up.
- C. The Contractor shall coordinate the work of the system manufacturer's service personnel, as necessary. This shall include the installation, interconnection, testing, and calibration of the instruments, and the scheduling of the manufacturer's service personnel.
- D. The Instrumentation System Supplier shall perform factory testing and checkout of each panel prior to delivery. Submit factory test reports and panel certifications.

- E. Each panel shall be tested and checked out in the field to confirm each input and output connected to instrumentation and other devices. Submit testing and checkout reports to the Engineer with final start-up schedule and request for Engineer witnessed testing.

3.03 TRAINING:

- A. Provide the services of authorized manufacturers' representatives to instruct the Owner's representatives in the proper operation and basic troubleshooting of the PLC and I/O system of each instrument and device installed under this Contract.
- B. Instrumentation training should be conducted by a qualified manufacturer's representative or person certified by the manufacturer in training of the equipment. This training should be conducted when all instrumentation is installed, calibrated, and after installation has been certified by the manufacturer's representative.
- C. Operator training shall be provided for a minimum of one, 4-hour training session (not including travel time) for the overall instrumentation and control system after system acceptance by the Engineer.
- D. The Supplier shall provide complete documentation for all systems prior to Owner/Engineer witness testing.
- E. All training and instructions shall be scheduled at the convenience of the Engineer and the Owner and shall be scheduled with at least five (5) days written notice.

END OF SECTION

\\wse03.local\WSE\Projects\NH\Rochester, NH\ENG23-0367 Ledgeview PS Final Design\090 - Specifications\Division 40 - Process Integration\40 95 13 Control Panels.docx

40 95 13 Attachment A IO Signal List

City of Rochester, NH

PROJECT NO. ENG23-0367

DATE: 10/02/23

Pump Station Control Panel MCP						
TAG NO	DESCRIPTION	DI	DO	AI	AO	
P-1	Pump 1 On/Off Status	1				
	Pump 1 VFD Fault	1				
	Pump 1 High Temperature Alarm	1				
	Pump 1 Ready Status	1				
	Pump 1 Lead Control	1				
	Pump 1 Lag Control	1				
	Pump 1 Auto Alternator Control	1				
	Pump 1 Start/Stop		1			
	Pump 1 Default Speed		1			
	Pump 1 VFD Speed Feedback			1		
	Pump 1 VFD Speed Control				1	
	P-2	Pump 2 On/Off Status	1			
		Pump 2 VFD Fault	1			
Pump 2 High Temperature Alarm		1				
Pump 2 Ready Status		1				
Pump 2 Lead Control		1				
Pump 2 Lag Control		1				
Pump 2 Auto Alternator Control		1				
Pump 2 Start/Stop			1			
Pump 2 Default Speed			1			
Pump 2 VFD Speed Feedback				1		
Pump 2 VFD Speed Control					1	
FM-1		Discharge Flowmeter Flow			1	
LE-1		Wetwell Level			1	
LS-1	Wetwell Level Switch High Water Alarm	1				
PF-101	Utility Power Fail Alarm	1				
PF-102	Panel Power Fail Alarm	1				
AL-104	Building Door Switch Alarm	1				
FA-101	Building Fire Alarm	1				
TS-101	Building Low/High Temperature Alarm	1				
AL-105	Personnel Emergency	1				
PLC-101	PLC Fail		1			
AL-103	Building Intrusion Alarm		1			
AL-101	Panel Alarm Horn		1			
AL-102	Alarm Acknowledge Pushbutton	1				
ENG-1	Engine Run	1				
	Engine Fail	1				
ATS-1	Utility Position	1				
	Generator Position	1				
TOTALS (With 25% Spare)		33	9	5	3	