



# **EFFLUENT CHARACTERISTIC DESIGN AT EMBDEN REARING STATION**

## **CONSTRUCTION DOCUMENTS PROJECT MANUAL**

**ISSUED FOR BID**

**SEPTEMBER 11, 2024**

**HDR Project No. 10377389**

**BGS Project No. 3289**

**Other Project No.**

**Maine Department of Inland Fisheries and Wildlife**

**41 State House Station**

**Augusta, Maine 04333**



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# TABLE OF CONTENTS

## **DIVISION 00 — PROCUREMENT AND CONTRACTING REQUIREMENTS**

- 00 01 07 - SEALS AND SIGNATURES
- 00 11 13 - NOTICE TO CONTRACTORS FOR EMAIL BID
- 00 21 13 - INSTRUCTIONS TO BIDDERS
- 00 41 13 - CONTRACTOR BID FORM
- 00 43 13 - CONTRACTOR BID BOND SAMPLE
- 00 52 13 - CONTRACT AGREEMENT SAMPLE
- 00 61 13.13 - CONTRACTOR PERFORMANCE BOND SAMPLE
- 00 61 13.16 - CONTRACTOR PAYMENT BOND SAMPLE
- 00 62 76 - BGS APPLICATION FOR PAYMENT
- 00 62 76.01 - BGS CONTINUATION SHEET
- 00 63 46 - CONSTRUCTION CHANGE DIRECTIVE
- 00 63 63 - CHANGE ORDER
- 00 71 00 - DEFINITIONS
- 00 72 13 - GENERAL CONDITIONS
- 00 72 14 - SUPPLEMENTAL GENERAL CONDITIONS
- 00 73 46 - WAGE DETERMINATION SCHEDULE

## **DIVISION 01 — GENERAL REQUIREMENTS**

- 01 11 00 - SUMMARY OF WORK
- 01 26 13 - REQUESTS FOR INFORMATION (RFI)
- 01 29 73 - SCHEDULE OF VALUES (LUMP SUM PROJECTS)
- 01 30 00 - SPECIAL CONDITIONS
- 01 32 17 - CONSTRUCTION PROGRESS SCHEDULE
- 01 33 00 - SUBMITTALS
- 01 33 04 - OPERATION AND MAINTENANCE MANUALS
- 01 35 73 - DELEGATED DESIGN PROCEDURES
- 01 42 13 - STANDARD ABBREVIATIONS AND SYMBOLS
- 01 45 00 - QUALITY ASSURANCE AND CONTROL
- 01 45 25 - TESTING CONCRETE STRUCTURES FOR WATERTIGHTNESS
- 01 45 33 - SPECIAL INSPECTIONS AND TESTING PROGRAM
- 01 61 03 - EQUIPMENT - BASIC REQUIREMENTS
- 01 65 50 - PRODUCT DELIVERY, STORAGE, AND HANDLING
- 01 71 14 - MOBILIZATION AND DEMOBILIZATION
- 01 71 23 - FIELD ENGINEERING
- 01 73 20 - OPENINGS AND PENETRATIONS IN CONSTRUCTION
- 01 73 29 - DEMOLITION, CUTTING AND PATCHING
- 01 74 23 - CLEANING
- 01 75 00 - FACILITY START-UP
- 01 77 00 - CONTRACT CLOSEOUT (GC)
- 01 78 23 - OPERATION AND MAINTENANCE DATA
- 01 78 36 - WARRANTIES
- 01 78 39 - PROJECT RECORD DOCUMENTS
- 01 78 43 - SPARE PARTS, TOOLS AND MAINTENANCE MATERIALS
- 01 91 03 - COMPONENT AND SYSTEM COMMISSIONING

## **DIVISION 02 — EXISTING CONDITIONS**

- 02 00 00 - EXISTING CONDITIONS

## **DIVISION 03 — CONCRETE**

- 03 05 05 - CONCRETE TESTING AND INSPECTION
- 03 11 13 - FORMWORK
- 03 15 19 - ANCHORAGE TO CONCRETE
- 03 21 00 - REINFORCEMENT

03 31 30 - CONCRETE MATERIALS AND PROPORTIONING  
03 31 31 - CONCRETE MIXING, PLACING, JOINTING, AND CURING  
03 35 00 - CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS  
03 41 33 - PRECAST AND PRESTRESSED CONCRETE

**DIVISION 04 — MASONRY**

04 01 20 - MASONRY CLEANING  
04 05 13 - MASONRY MORTAR AND GROUT  
04 05 23 - MASONRY ACCESSORIES  
04 05 50 - COLD AND HOT WEATHER MASONRY CONSTRUCTION  
04 22 00 - CONCRETE MASONRY

**DIVISION 05 — METALS**

05 50 00 - METAL FABRICATIONS  
05 52 43 - WELDED ALUMINUM RAILINGS

**DIVISION 06 — WOOD, PLASTICS, AND COMPOSITES**

06 10 00 - ROUGH CARPENTRY  
06 17 53 - METAL PLATE CONNECTED WOOD TRUSSES  
06 82 00 - MATS & FIBERGLASS REINFORCED PLASTIC FABRICATIONS  
06 85 14 - FRP WEIRS AND BAFFLES

**DIVISION 07 — THERMAL AND MOISTURE PROTECTION**

07 13 26 - SELF-ADHERING SHEET MEMBRANE WATERPROOFING  
07 21 00 - BUILDING INSULATION  
07 26 00 - UNDER SLAB VAPOR RETARDER  
07 61 13 - METAL ROOFING  
07 62 00 - FLASHING AND SHEET METAL  
07 92 00 - JOINT SEALANTS

**DIVISION 08 — OPENINGS**

08 11 00 - HOLLOW METAL DOORS AND FRAMES  
08 51 13 - ALUMINUM WINDOWS  
08 70 00 - FINISH HARDWARE  
08 90 00 - LOUVERS AND VENTS

**DIVISION 09 — FINISHES**

09 77 61 - FIBERGLASS REINFORCED PLASTIC (FRP) PANELS  
09 91 10 - ARCHITECTURAL PAINTING  
09 96 00 - HIGH PERFORMANCE INDUSTRIAL COATINGS

**DIVISION 10 — SPECIALTIES**

10 14 00 - IDENTIFICATION DEVICES  
10 44 33 - FIRE PROTECTION SPECIALTIES

**DIVISION 23 — HEATING VENTILATING AND AIR CONDITIONING**

23 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING AND HVAC EQUIPMENT  
23 30 00 - HVAC AIR DISTRIBUTION

**DIVISION 26 — ELECTRICAL**

26 05 00 - ELECTRICAL - BASIC REQUIREMENTS  
26 05 19 - WIRE AND CABLE - 600 VOLT AND BELOW  
26 05 26 - GROUNDING AND BONDING  
26 05 33 - RACEWAYS AND BOXES  
26 05 43 - ELECTRICAL - EXTERIOR UNDERGROUND  
26 08 13 - ACCEPTANCE TESTING  
26 09 16 - CONTROL EQUIPMENT ACCESSORIES  
26 24 16 - PANELBOARDS  
26 24 19 - MOTOR CONTROL EQUIPMENT

26 27 26 - WIRING DEVICES  
26 28 00 - OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES  
26 28 16 - SAFETY SWITCHES  
26 29 23 - VARIABLE FREQUENCY DRIVES - LOW VOLTAGE  
26 36 00 - TRANSFER SWITCHES  
26 43 13 - LOW VOLTAGE SURGE PROTECTION DEVICES (SPD)  
26 50 00 - INTERIOR AND EXTERIOR LIGHTING

**DIVISION 31 — EARTHWORK**

31 10 00 - SITE CLEARING  
31 23 00 - EARTHWORK  
31 23 33 - TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES  
31 25 00 - SOIL EROSION AND SEDIMENT CONTROL  
31 32 19 - GEOTEXTILES

**DIVISION 32 — EXTERIOR IMPROVEMENTS**

32 12 16 - ASPHALTIC CONCRETE VEHICULAR PAVING  
32 15 40 - CRUSHED STONE SURFACING  
32 31 13 - CHAIN LINK FENCE AND GATES  
32 91 13 - TOPSOILING AND FINISHED GRADING  
32 92 00 - SEEDING, SODDING AND LANDSCAPING

**DIVISION 33 — UTILITIES**

33 05 16 - PRECAST CONCRETE MANHOLE STRUCTURES  
33 05 23 - PIPELINE UNDERCROSSINGS  
33 11 15 - WATER WELLS  
33 46 00 - FOUNDATION AND UNDERSLAB DRAINAGE SYSTEM

**DIVISION 40 — PROCESS INTERCONNECTIONS**

40 05 00 - PIPE AND PIPE FITTINGS - BASIC REQUIREMENTS  
40 05 07 - PIPE SUPPORT SYSTEMS  
40 05 19 - PIPE - DUCTILE  
40 05 24 - PIPE - STEEL  
40 05 31 - PIPE - PLASTIC  
40 05 51 - VALVES - BASIC REQUIREMENTS  
40 05 52 - MISCELLANEOUS VALVES  
40 05 61 - GATE VALVES  
40 05 62 - PLUG VALVES  
40 05 63 - BALL VALVES  
40 05 64 - BUTTERFLY VALVES  
40 05 66 - CHECK VALVES  
40 41 13 - HEAT TRACING CABLE  
40 42 00 - PIPE, DUCT AND EQUIPMENT INSULATION  
40 71 00 - FLOW INSTRUMENTATION

**DIVISION 43 — PROCESS GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT**

43 21 00 - PUMPING EQUIPMENT - BASIC REQUIREMENTS  
43 22 56 - LIQUID PROCESS EQUIPMENT - SLUDGE TANK MIXING  
43 22 71 - PROCESS POLY TRENCH DRAINS AND FLOOR SINKS  
43 23 13.19 - OVERHUNG HORIZONTAL SELF-PRIMING CENTRIFUGAL PUMPS  
43 25 13 - SUBMERSIBLE NON-CLOG PUMPS

**DIVISION 46 — WATER AND WASTEWATER EQUIPMENT**

46 13 01 - ALUMINUM COVERS - DOME TYPE  
46 13 15 - ALUMINUM COVERS - FORMED PANEL TYPE  
46 33 11 - CHEMICAL FEED - LIQUID SYSTEMS  
46 43 22 - CIRCULAR CLARIFIER EQUIPMENT

46 71 33 - ROTARY DRUM FILTER

**APPENDIX**

A - GEOTECHNICAL REPORT FOR EMBDEN REARING STATION



## DIVISION 00


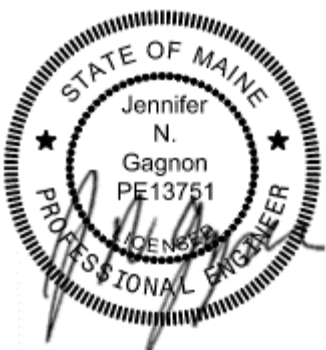
### PROCUREMENT AND CONTRACTING REQUIREMENTS


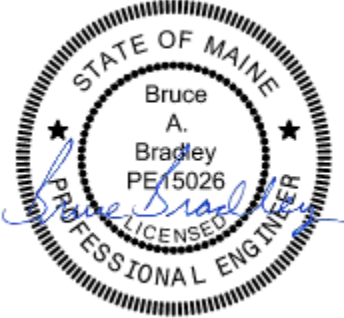



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**00 01 07**  
**SEALS AND SIGNATURES**

**Owner Name:** Maine Department of Inland Fisheries and Wildlife  
**Facility or Site Name:** Embden Rearing Station  
**Project Name:** Department of Inland Fish and Wildlife Effluent Design  
**Project or Contract Designation:** BGS Project No. 3289  
**Engineer:** HDR

<p>Jeffrey K. Chandler, PE Maine License No. PE17167</p> 	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"><li>• Division 00</li><li>• Division 01.</li><li>• Division 02.</li><li>• 06 85 14</li><li>• 09 96 00</li><li>• 11 03 85</li><li>• Division 23</li><li>• Division 33</li><li>• Division 40</li><li>• Division 43</li><li>• 46 43 22</li><li>• 46 71 33</li></ul>
<p>Jennifer N. Gagnon, PE Maine License No. PE13751</p> 	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"><li>• Division 31.</li><li>• Division 32</li><li>•</li></ul>

<p>Michael A. Baskin, PE Maine License No. PE5595</p> 	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> <li>• 06 10 00</li> <li>• 06 82 00</li> <li>• Division 08</li> <li>• 09 29 00</li> <li>• 09 77 61</li> <li>• 09 91 10</li> <li>• Division 10</li> </ul>
<p>Bruce A. Bradley, PE Maine License No. PE15026</p> 	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> <li>• 01 45 33.</li> <li>• Division 03</li> <li>• Division 04</li> <li>• Division 05.</li> <li>• 06 17 53</li> <li>• Division 07</li> <li>• Division 13</li> <li>• 46 13 01</li> <li>• 46 13 15</li> </ul>
<p>Andrew D. Kaner, PE Maine License No. PE18016</p> 	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> <li>• Division 26.</li> </ul>

Engineer's seal and signature does not apply to the documents that comprise Division 00, Bidding and Contracting Requirements.

It is a violation of applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the Specifications in this project manual.



## END OF SEALS AND SIGNATURES

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**00 11 13**  
**Notice to Contractors**

**EFFLUENT CHARACTERISTIC DESIGN AT EMBDEN REARING STATION**

BGS project No.: 3289

*This project will replace the existing open air concrete clarifier and sludge storage tanks with new covered sludge storage and clarifier tanks. This project will also replace existing piping and install a new clarifier solids pump building. A Bid Alternate 1 has been included in this bid set with the potential to install a chemical dosing and pump building.*

The contract shall designate the Substantial Completion Date on or before **31 December 2025**, and the Contract Final Completion Date on or before **30 June 2026**.

1. Submit bids on a completed Contractor Bid Form (section 00 41 13), provided in the Bid Documents, include bid security when required, and scan each item as an attachment to an email addressed to: BGS.Architect@Maine.gov, so as to be received no later than **2:00:00 p.m. on Thursday, October 24, 2024**. The email subject line shall be marked "**Bid for EFFLUENT CHARACTERISTIC DESIGN AT EMBDEN REARING STATION**".

Bid submissions will be opened and read aloud at the time and date noted above at the Bureau of General Services office, accessible as a video conference call. Those who wish to participate in the call must submit a request for access to BGS.Architect@Maine.gov.

Any bid received after the noted time will not be considered a valid bid and will remain unopened. Any bid submitted by any other means will not be considered a valid bid. In certain circumstances, the Bureau of General Services may require the Bidder to surrender a valid paper copy of the bid form or the bid security document. The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.

2. Questions and comments on the *bid opening process* shall be addressed to: Division of Planning, Design & Construction, Bureau of General Services, 77 State House Station, Augusta, Maine 04333-0077, BGS.Architect@Maine.gov.
3. Questions and comments regarding the *project* design specifications or drawings shall be directed in writing to the Consultant during the bid period prior to the question and comment deadline of 5:00 p.m. on *Thursday, October 17, 2024*.

*HDR*

*Andrew Gurski*

*Andrew.gurski@hdrinc.com*

4. ☒ Bid security is required on this project.  
The Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with the completed bid form submitted to the Owner. The Bid Bond form is available on the BGS website.

*or*

- ☐ Bid security is not required on this project.

**00 11 13**  
**Notice to Contractors**

5. ☒ Performance and Payment Bonds are required on this project.  
If noted above as required, or if any combination of Base Bid and Alternate Bids amounts selected in the award of the contract exceeds \$125,000.00, the selected Contractor shall furnish a 100% contract Performance Bond (section 00 61 13.13) and a 100% contract Payment Bond (section 00 61 13.16) in the contract amount to cover the execution of the Work. Bond forms are available on the BGS website.  
*or*  
☐ Performance and Payment Bonds are not required on this project.
6. Filed Sub-bids *are not required* on this project.
7. ☒ Pre-qualified General Contractors are utilized on this project.  
*insert the company name, city and state for each*  
*or*  
☒ Pre-qualified General Contractors are not utilized on this project.
8. ☒ An on-site pre-bid conference ( ☐ *mandatory* or ☒ *optional* ) will be conducted for this project.  
The pre-bid conference is intended for General Contractors. Subcontractors and suppliers are welcome to attend. Contractors who arrive late or leave early for a mandatory meeting may be prohibited from participating in this meeting and bidding.  
***Tuesday, 08 October 2024 @ 11:30 am***  
*On site at the Embden Fish Rearing Station*  
*located at 809 Cross Town Rd, Embden, ME 04958*  
*or*  
☐ An on-site pre-bid conference will not be conducted for this project.
9. Bid Documents - full sets only - will be available on or about **23 September 2024** and may be obtained *at no cost* from:  
*<https://www.maine.gov/dafs/bgs/business-opportunities#invitationforbid>*
10. Bid Documents may be examined at:
- |  |  |
|--|--|
| <i>AGC Maine</i>                           | <i>Construction Summary</i>                      |
| <i>188 Whitten Road, Augusta, ME 04330</i> | <i>734 Chestnut Street, Manchester, NH 03104</i> |
| <i>207-622-4741</i>                        | <i>603-627-8856</i>                              |

**Instructions to Bidders****1. Bidder Requirements**

- 1.1 A bidder is a Contractor which is evidently qualified, or has been specifically pre-qualified by the Bureau of General Services, to bid on the proposed project described in the Bid Documents.
- 1.2 Contractors and Subcontractors bidding on projects that utilize Filed Sub-bids shall follow the requirements outlined in these Bid Documents for such projects.
- 1.3 Contractors and Subcontractors are not eligible to bid on the project when their access to project design documents prior to the bid period distribution of documents creates an unfair bidding advantage. Prohibited access includes consultation with the Owner or with design professionals engaged by the Owner regarding cost estimating, constructability review, or project scheduling. This prohibition to bid applies to open, competitive bidding or pre-qualified contractor bidding or Filed Sub-bidding. The Bureau may require additional information to determine if the activities of a Contractor constitute an unfair bidding advantage.
- 1.4 Each bidder is responsible for becoming thoroughly familiar with the Bid Documents prior to submitting a bid. The failure of a bidder to review evident site conditions, to attend available pre-bid conferences, or to receive, examine, or act on addenda to the Bid Documents shall not relieve that bidder from any obligation with respect to their bid or the execution of the work as a Contractor.
- 1.5 Prior to the award of the contract, General Contractor bidders or Filed Sub-bidders may be required to provide documented evidence to the Owner or the Bureau showing compliance with the provisions of this section, their business experience, financial capability, or performance on previous projects.
- 1.6 The selected General Contractor bidder will be required to provide proof of insurance before a contract can be executed.
- 1.7 Contracts developed from this bid shall not be assigned, sublet or transferred without the written consent of the Owner.
- 1.8 By submitting a bid the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Director of the Bureau of General Services may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.
- 1.9 The Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

**Instructions to Bidders**

- 1.10 The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.
2. Authority of Owner
  - 2.1 The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.
  - 2.2 Subject to the Owner's stated right to accept or reject any or all bids, the Contractor shall be selected on the basis of the lowest dollar value of an acceptable Base Bid, or any combination of Base Bid plus Alternate Bids, as well as other limited cost modifications the Owner determines may best serve the interests of the Owner. An acceptable bid is a duly submitted bid from a responsive and responsible bidder.
  - 2.3 The Owner reserves the right to require Bid Bonds or Performance and Payment Bonds for any project of any contract value.
3. Submitting Bids and Bid Requirements
  - 3.1 Each bid shall be submitted on the forms provided in the Bid Documents.
  - 3.2 Each bid shall be valid for a period of thirty calendar days following the Project bid closing date and time. The bid expiration date may be extended in unusual circumstances by mutual consent of the Bidder and the Owner. The bid amount shall not be modified due to the bid expiration date extension.
  - 3.3 Any provision contained in a bid which shows cost escalation, or any modification of schedule or other requirements shall not be accepted. Such a provision causes the bid to be invalid, or, at the discretion of the Owner and BGS, that element of the bid submission may be disregarded for the purpose of awarding the contract without that provision.
  - 3.4 Bidders shall include a Bid Bond or other approved bid security with the bid form submitted to the Owner when the bid form indicates such bid security is required. The bond value shall be 5% of the bid amount. The form of bond is shown in section 00 43 13.
  - 3.5 Bidders recognize that inclusion of contract bonds and the cost of those bonds is dependent on the awarded contract dollar value. Therefore, a Base Bid, or any combination of Base Bid plus Alternate Bids, as well as other limited cost modifications, resulting in a contract award shall include the cost of Performance and Payment Bonds in the submitted bid amount when the construction contract value is over \$125,000.00. Similarly, the cost of Performance and Payment Bonds is excluded in the submitted bid amount when the construction contract value is \$125,000.00 or less unless bonds are specifically required by the Bid Documents. When required for the project, the selected Contractor shall provide these bonds before a contract can be executed, pursuant to 14 M.R.S.A., Section 871, Public Works Contractors' Surety Bond Law of 1971, subsection 3. The form of bonds is shown in section 00 61 13.13 and 00 61 13.16.

**00 21 13**  
**Instructions to Bidders**

- 3.6 Bidders may modify bids in writing, by the same means as the original bid submission, prior to the bid closing time. Such written amendments shall not disclose the amount of the initial bid. If so disclosed, the entire bid is considered invalid.
- 3.7 Bidders implicitly acknowledge all Addenda issued when they submit the bid form. By usual practice the Consultant shall not issue Addenda less than 72 hours prior to the bid closing time, to allow ample time for bidders to incorporate the information. However, some information, such as extending the bid due date and time, may be issued with shorter notice. Addenda shall be issued to all companies who are registered holders of Bid Documents.
- 3.8 A bid may be withdrawn without penalty if a written request by the bidder is presented to the Owner prior to the bid closing time. Such written withdrawal requests are subject to verification as required by the Bureau.
- A bid may be withdrawn without penalty after the bid closing time if, in the determination of the Bureau, evidence provided by the Contractor shows an apparent unintended error such as a miscalculation, or an erroneous number on estimating documents, was the cause of an inaccurate bid. The Bureau may allow withdrawal in consideration of the bid bond or, without utilizing a bid bond, if the Bureau considers documented evidence provided by the Contractor shows factual errors had been made on the bid form.
- 3.9 In the event State of Maine Offices unexpectedly close on the published date of a public bid opening in the location of that bid opening, prior to the time of the scheduled deadline, the new deadline for the public bid opening will be the following business day at the originally scheduled hour of the day, at the original location. Official closings are posted on the State of Maine government website.
- 3.10 The Owner may require, in a Notice of Intent to Award letter to the apparent low bidder, a Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers as both a demonstration of capability of the Bidder and as a condition of award.
- 3.11 Projects which require a State of Maine wage determination will include that schedule as part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.12 Projects which require compliance with the Davis-Bacon Act are subject to the regulations contained the Code for Federal Regulations and the federal wage determination which is made a part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.13 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.

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**00 41 13**  
**Contractor Bid Form**

**Effluent Characteristic Design at Embden Rearing Station**

BGS project No.: 3289

Bid Form submitted by: *email only to email address below*

Bid Administrator:

*Robert Gurney*  
Bureau of General Services  
111 Sewall Street, Cross State Office Building, 4th floor  
77 State House Station  
Augusta, Maine 04333-0077

BGS.Architect@Maine.gov

Bidder:

Signature: \_\_\_\_\_

Printed name and  
title: \_\_\_\_\_

Company name: \_\_\_\_\_

Mailing address: \_\_\_\_\_

City, state, zip code: \_\_\_\_\_

Phone number: \_\_\_\_\_

Email address: \_\_\_\_\_

State of  
incorporation,  
if a corporation: \_\_\_\_\_

List of all partners,  
if a partnership: \_\_\_\_\_

The Bidder agrees, if the Owner offers to award the contract, to provide any and all bonds and certificates of insurance, as well as Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers if required by the Owner, and to sign the designated Construction Contract within twelve calendar days after the date of notification of such acceptance, except if the twelfth day falls on a State of Maine government holiday or other closure day, or a Saturday, or a Sunday, in which case the aforementioned documents must be received before 12:00 noon on the first available business day following the holiday, other closure day, Saturday, or Sunday.

As a guarantee thereof, the Bidder submits, together with this bid, a bid bond or other acceptable instrument as and if required by the Bid Documents.

**00 41 13**  
**Contractor Bid Form**

1. The Bidder, having carefully examined the **Effluent Characteristic Design at Embden Rearing Station** Project Manual dated **September 11, 2024** prepared by HDR Engineering, INC., as well as Specifications, Drawings, and any Addenda, the form of contract, and the premises and conditions relating to the work, proposes to furnish all labor, equipment and materials necessary for and reasonably incidental to the construction and completion of this project for the **Base Bid** amount of:

\$ \_\_\_\_\_ .00

2. Allowances *are not included* on this project.

*No Allowances*

*insert brief name of Allowance*

\$ 0.00

3. Alternate Bids *are included* on this project.

Any dollar amount line below that is left blank by the Bidder shall be read as a bid of **\$0.00**.

*1 Bid Alternate 1* \$ \_\_\_\_\_ .00

*1 Not Used* \$ \_\_\_\_\_ .00

*1 Not Used* \$ \_\_\_\_\_ .00

*1 Not Used* \$ \_\_\_\_\_ .00

4. Bid security *is required* on this project.

If noted above as required, or if the Base Bid amount exceeds \$125,000.00, the Bidder shall include with this bid form a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with this completed bid form submitted to the Owner.

5. Filed Sub-bids *are not required* on this project.

If noted above as required, the Bidder shall include with this bid form a list of each Filed Sub-bidder selected by the Bidder on the form provided (section 00 41 13F).

**00 43 13**  
**Contractor Bid Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of *five percent of the bid amount*, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns, signed this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the first specified bid due date, or subsequent bid due date revised by addendum.

The condition of the above obligation is such that whereas the principal has submitted to the Owner, or State of Maine, to a certain bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, for the construction of insert name of project as designated in the contract documents

Now therefore:

If said bid shall be rejected, or, in the alternate,

If said bid shall be accepted and the principal shall execute and deliver a contract in the form of contract attached hereto, properly completed in accordance with said bid, and shall furnish a bond for the faithful performance of said contract, and for the payment of all persons performing labor or furnishing material 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 obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time within which the Obligee may accept such bid and said Surety does hereby waive notice of any such extension.

**00 43 13**  
**Contractor Bid Bond**

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 above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the first specified bid due date, or subsequent bid due date revised by addendum.

**Contractor**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

**Surety**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

## State of Maine CONSTRUCTION CONTRACT

### Large Construction Project

*This form is used when the Contract value is \$50,000 or greater.  
The Project Manual, Specifications and Drawings, and any Addenda are considered part of this Contract.*

Agreement entered into by and between the contracting entity name hereinafter called the **Owner** and Contractor company name hereinafter called the **Contractor**.

BGS Project No.: number assigned by BGS

Other Project No.: \_\_\_\_\_

For the following Project: title of project as shown on bid documents at facility or campus name, municipality, Maine.

The Specifications and the Drawings have been prepared by Consultant firm name, acting as Professional-of-Record and named in the documents as the Consultant Architect or Engineer.

The *Owner* and *Contractor* agree as follows:

#### ARTICLE 1 COMPENSATION AND PAYMENTS

**1.1** The Owner shall pay the Contractor to furnish all labor, equipment, materials and incidentals necessary for the construction of the Work described in the Specifications and shown on the Drawings the Contract Amount as shown below.

Base Bid	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<b>Total Contract Amount</b>	<b><u>\$0.00</u></b>

**1.2** The Contractor's requisition shall contain sufficient detail and supporting information for the Owner to evaluate and support the payment requested.

**1.2.1** Payments are due and payable twenty-five working days from the date of receipt of a Contractor requisition which is approved by the Owner.

**1.2.2** Provisions for late payments are governed by 5 M.R.S. Chapter 144, *Payment of Invoices Received from Business Concerns*, and interest shall be calculated at 1% per month.

#### ARTICLE 2 COMMENCEMENT AND COMPLETION DATES

**2.1** The Work of this Contract shall commence no sooner than the date this document is executed by the approval authority, or a subsequent date designated in the contract documents.

**2.2** The Substantial Completion Date shall be \_\_\_\_\_.

**2.3** The Work of this Contract shall be completed on or before the Contract Final Completion Date of \_\_\_\_\_.

**2.4** The Contract Expiration Date shall be \_\_\_\_\_. (This date is the Owner's deadline for internal management of contract accounts. The Contract Expiration Date does not directly relate to any contract obligation of the Contractor.)

### **ARTICLE 3 INELIGIBLE BIDDER**

**3.1** By signing this contract the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Bureau of General Services may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.

**3.2** By signing this contract the Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

**3.3** The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.

### **ARTICLE 4 CONTRACTOR'S RESPONSIBILITIES**

**4.1** On this project, the Contractor shall furnish the Owner the appropriate contract bonds in the amount of 100% of the Contract Sum. Contract bonds are mandated if the Contract Sum exceeds \$125,000, or if bonds are specifically required by the Contract Documents.

**4.2** The Contractor shall comply with all laws, codes and regulations applicable to the Work.

**4.3** The Contractor shall acquire all permits and third-party approvals applicable to the Work not specifically identified as provided by the Owner. Costs for Contractor-provided permits and third-party approvals shall be included in the Contract Sum identified in Section 1.1 above.

**4.4** The Contractor shall remain an independent agent for the duration of this Contract, shall not become an employee of the State of Maine, and shall assure that no State employee will be compensated by, or otherwise benefit from, this Contract.

**4.5** The Contractor shall be responsible for any design cost, construction cost, or other cost incurred on the Project to the extent caused by the negligent acts, errors or omissions of the Contractor or their Subcontractors in the performance of Work under this Contract.

**ARTICLE 5 OWNER'S RESPONSIBILITIES**

**5.1** The Owner shall provide full information about the objectives, schedule, constraints and existing conditions of the project. The Owner has established a budget with reasonable contingencies that meets the project requirements.

**5.2** By signing this contract, the Owner attests that all State of Maine procurement requirements for this contract have been met, including the solicitation of competitive bids.

**ARTICLE 6 INSTRUMENTS OF SERVICE**

**6.1** The Contractor's use of the drawings, specifications and other documents known as the Consultant's Instruments of Service is limited to the execution of the Contractor's scope of work of this project unless the Contractor receives the written consent of the Owner and Consultant for use elsewhere.

**ARTICLE 7 MISCELLANEOUS PROVISIONS**

**7.1** This Contract shall be governed by the laws of the State of Maine.

**7.2** The Owner and Contractor, respectively, bind themselves, their partners, successors, assigns and legal representatives to this Contract. Neither party to this Contract shall assign the Contract as a whole without written consent of the other party, which consent the Owner may withhold without cause.

**7.3** Notwithstanding any other provision of this Agreement, if the Owner does not receive sufficient funds to fund this Agreement or funds are de-appropriated, or if the Owner does not receive legal authority from the Maine State Legislature or Maine Courts to expend funds intended for this Agreement, then the Owner is not obligated to make payment under this Agreement; provided, however, the Owner shall be obligated to pay for services satisfactorily performed prior to any such non-appropriation in accordance with the termination provisions of this Agreement. The Owner shall timely notify the Contractor of any non-appropriation and the effective date of the non-appropriation.

**ARTICLE 8 CONTRACT DOCUMENTS**

**8.1** The Project Manual, Specifications and Drawings, and any Addenda, together with this agreement, form the contract. Each element is as fully a part of the Contract as if hereto attached or herein repeated.

**8.2** Specifications: *indicate date of issuance of project manual*

**8.3** Drawings: *note here or attach each sheet number and title*

**8.4** Addenda: *note each addenda number and date, or "none"*

BGS Project No.: \_\_\_\_\_

The Contract is effective as of the date executed by the approval authority.

**OWNER****CONTRACTOR**

\_\_\_\_\_  
*Signature Date*  
*name and title*

*name of contracting entity*  
*address*

*telephone*  
*email address*

\_\_\_\_\_  
*Signature Date*  
*name and title*

*name of contractor company*  
*address*

*telephone*  
*email address*  
*Vendor Number*

Indicate the names of the review and approval individuals appropriate to the approval authority.

**select proper approval authority****Reviewed by:****Approved by:**

\_\_\_\_\_  
*Signature Date*  
*insert name*  
 \_\_\_\_\_  
*Project Manager/ Contract Administrator*

\_\_\_\_\_  
*Signature Date*  
*Robert Gurney, P.E.*  
 \_\_\_\_\_  
*Chief Engineer, Bureau of General Services*



**00 61 13.13**  
**Contractor Performance Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly and faithfully perform the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, then this obligation shall be null and 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 obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

**00 61 13.13**

**Contractor Performance Bond**

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 above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

**Contractor**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

**Surety**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**00 61 13.16**  
**Contractor Payment Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the use and benefit of claimants, defined as an entity having a contract with the principal or with a subcontractor of the principal for labor, materials, or both labor and materials, used or reasonably required for use in the performance of the contract, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly satisfy all claims and demands incurred for all labor and materials, used or required by the principal in connection with the work described in the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, and shall fully reimburse the obligee for all outlay and expense with said obligee may incur in making good any default of said principal, then this obligation shall be null and 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 obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

**00 61 13.16**  
**Contractor Payment Bond**

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 above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

**Contractor**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

**Surety**

\_\_\_\_\_  
(Signature)

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**State of Maine**  
**CONSTRUCTION CONTRACT**  
**Application for Payment**

**Project name**

location / school / campus

Application Number: **1****Contractor Company name**

address

city state zip code

Period Start Date:

Period End Date:

BGS Project No.: **n**Other Project No.: **x**

1	Original Contract Amount		<b>\$0</b>
2	Net of Change Orders to Date (from table below)		<b>\$0</b>
3	Contract Sum to Date (line 1 plus or minus line 2)		<b>\$0</b>
4	Total Completed and Stored to Date (column G on Continuation Sheet)		<b>\$0</b>
5a	5% Retainage of Completed Work (columns D + E x 5%)	<b>\$0</b>	
5b	5% Retainage of Stored Materials (column F x 5%)	<b>\$0</b>	
5c	Total Retainage (column I)		<b>\$0</b>
6	Total Earned Less Retainage (line 4 minus line 5c)		<b>\$0</b>
7	Less Previous Approved Applications for Payment (line 6 from previous Application)		<b>\$0</b>
8	Current Payment Due (line 6 minus line 7)		<b>\$0</b>
9	Balance to Finish, Including Retainage (line 3 minus line 6)	<b>\$0</b>	

Change Order Summary	Additions	Deductions
Total Changes Approved in Previous Months	<b>\$0</b>	<b>\$0</b>
Total Changes Approved this Month	<b>\$0</b>	<b>\$0</b>
Subtotals	<b>\$0</b>	<b>\$0</b>
Net of Change Orders to Date		<b>\$0</b>

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information, and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which the previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

**Contractor**

Type company name here

Type person's name, title here

signature

date

In accordance with the Contract Documents, based on on-site observations and the data comprising this Application, the Consultant certifies to the Owner that to the best of the Consultant's knowledge, information, and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the Amount Certified. **Amount Certified:** \_\_\_\_\_

**Consultant (Architect or Engineer)**

Type firm name here

Type person's name, title here

signature

date

**Owner**

Type contracting entity name here

Type person's name, title here

signature

date

**Owner's Rep / other - clear this text if not used**

Type entity name here

Type person's name, title here

signature

date

**Bureau of General Services**

Type person's name, title here

signature

date

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**State of Maine  
CONSTRUCTION CONTRACT  
Application for Payment - Continuation Sheet**

Application Number: **1**

Period Start Date:

Period End Date:

BGS Project No.: n

Other Project No.: X

page 1

of 1

Project name

Contractor Company name

[illegible]

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**State of Maine**  
**CONSTRUCTION CONTRACT**  
**Construction Change Directive**

**Project name**  
 location / school / campus

C. C. D. Number: **1**  
 CP (Change Proposal) Number: **1**  
 Issue Date of this Document: **31-Oct-2021**

**Contractor Company name**  
 address  
 city state zip code

BGS Project No.: **n**  
 Other Project No.: **x**

<b>CCD Item</b>	Type name of CCD item here		
<b>Description of Work</b>	Type brief description here of work scope here.		
<b>Reason or Necessity of Work</b>	Type brief justification for change here.		
<b>Method of Compensation</b>	Select from drop down box...	<b>Projected Total Cost</b>	\$0
<b>Supporting Documentation</b>	is attached	<b>Projected Calendar Days*</b>	0

\* Calendar Days refers to Contract Final Completion Date only.

Fully describe the scope of work of the CCD item in the table above and on attached drawings and specifications as necessary.

Indicate the reason for the work, and the estimated schedule and cost impacts.

This CCD records the order to do the work. The documented actual final time and cost changes are subject to approval in a subsequent Change Order process.

**Consultant**  
 (Architect or Engineer) Type firm name here  
 Type person's name, title here

-----  
 signature date

**Contractor**  
 Type company name here  
 Type person's name, title here

-----  
 signature date

**Owner**  
 Type contracting entity name here  
 Type person's name, title here

-----  
 signature date

**Owner's Rep**  
 Type entity name here  
 Type person's name, title here

-----  
 signature date

**Bureau of**  
**General Services** Division of Planning, Design & Construction  
 Type person's name, title here

-----  
 signature date

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**State of Maine**  
**CONSTRUCTION CONTRACT**  
**Change Order**

**Project name**

location / school / campus

Change Order Number: **1**Issue Date of this Document: **31-Dec-2022****Contractor Company name**

address

city state zip code

BGS Project No.: **n**Other Project No.: **x****Cost Change***Show Deduct as a negative number, e.g.: "-\$850".*

	Add	Deduct	Total
Net Amount of this Change Order	\$0	\$0	
Net Amount of Previous Change Orders	\$0	\$0	
Net of Change Orders to Date	\$0	\$0	\$0
Original Contract Amount			\$0
<b>Revised Contract Amount</b>			<b>\$0</b>

**Time Change***Show Deduct as a negative number, e.g.: "-8".*

	Add	Deduct	Total
Net Calendar Days Adjusted by this Change Order	0	0	
Net Calendar Days Adjusted by Previous Change Orders	0	0	
Net of Change Orders to Date	0	0	0
Original Contract Final Completion Date			31-Dec-2023
<b>Revised Contract Final Completion Date*</b>			<b>31-Dec-2023</b>

**Consultant (Architect or Engineer)**

Type firm name here

Type person's name, title here

signature

date

**Contractor**

Type company name here

Type person's name, title here

signature

date

**Owner**

Type contracting entity name here

Type person's name, title here

signature

date

**Type Entity, such as "Owner's Rep", or "not used"**

Type entity name here

Type person's name, title here

signature

date

**Bureau of General Services**

Division of Planning, Design &amp; Construction

Type person's name, title here

signature

date

Attach the "List of Change Order Items" sheet, plus all supporting documentation for each Change Order Item.

Substantial Completion Date: the deadline for first beneficial use by Owner, as certified by Consultant.

\* **Contract Final Completion Date** : the Contractor's final completion deadline for contract work.

Contract Expiration Date: the Owner's deadline for internal management of contract accounts;

Contract Expiration Date does not directly relate to any contract obligation of the Contractor.

1-Dec-2023

31-Dec-2023

29-Feb-2024

## List of Change Order Items

Project name

C. O. Number: 1

Contractor Company name

CO Item No.	CP No.	Item Name	Reason Code	Calendar Days*	Cost
1	1	Type brief name of Change Order Item here		0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
Totals				0	\$0

## Reason Codes

EO Error or omission of Consultant  
UC Unforeseen job site condition  
OC Owner-generated change  
RC Regulatory authority-generated change  
CC Contractor-generated change

\* Calendar Days shows Contract Final Completion Date impact only.

Attach this sheet to the BGS "Change Order" cover sheet (with cost and time summaries, and signatures). Attach a "Details" sheet, and other supporting documentation, for each Change Order Item listed above.

## Details of Change Order Item

## Project name

location / school / campus

Change Order Item Number

1

CP (Change Proposal) Number

1

Issue Date of this Document:

31-Oct-2021

## Contractor Company name

address

city state zip code

BGS Project No.:

n

Other Project No.:

x

<b>Change Order Item</b>	Type name of Change Order Item here			
<b>Description of Work</b>	Type brief description here of work scope here.			
<b>Reason or Necessity of Work</b>	Type brief justification for change here.			
<b>Cost Breakdown</b>	Work by Subcontractor only	Work by Sub and Contractor	Work by Contractor only	
Subcontractor base cost	\$0	\$0		
Subcontractor markup	\$0	\$0		
Contractor base cost		\$0	\$0	
Contractor markup	\$0	\$0	\$0	
Subtotal	\$0	\$0	\$0	
<b>Compensation</b>	lump sum		<b>Total Cost</b>	<b>\$0</b>
<b>Initiated by</b>	Consultant		<b>Calendar Days*</b>	0
<b>Reason Code</b>	CC	<b>Supporting Documentation</b>		is attached

*EO*  
Error or omission  
of Consultant

*UC*  
Unforeseen job site  
condition

*OC*  
Owner-  
generated change

*RC*  
Regulatory authority-  
generated change

*CC*  
Contractor-  
generated change

\* Calendar Days shows Contract Final Completion Date impact only.

## Consultant

(Architect or Engineer)

Type firm name here

Type person's name, title here

signature

date

## Contractor

Type company name here

Type person's name, title here

signature

date

## Owner

Type contracting entity name here

Type person's name, title here

signature

date

## Owner's Rep

Type entity name here

Type person's name, title here

signature

date

## Bureau of

Division of Planning, Design &amp; Construction

**General Services**

Type person's name, title here

-----  
signature

-----  
date

**00 71 00**  
**Definitions**

1. Definitions
  - 1.1 *Addendum*: A document issued by the Consultant that amends the Bid Documents. Addenda shall not be issued less than seventy-two hours prior to the specified bid opening time.
  - 1.2 *Allowance*: A specified dollar amount for a particular scope of work or service included in the Work that is identified in the Bid Documents and included in each Bidder's Bid. The Contractor shall document expenditures for an Allowance during the Project. Any unused balance shall be credited to the Owner. The Contractor is responsible for notifying the Owner of anticipated expenses greater than the specified amount and the Owner is responsible for those additional expenses.
  - 1.3 *Alternate Bid*: The Contractor's written offer of a specified dollar amount, submitted on the Bid Form, for the performance of a particular scope of work described in the Bid Documents. The Owner determines the low bidder based on the sum of the base Bid and any combination of Alternate Bids that the Owner selects.
  - 1.4 *Architect*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to "Consultant" in State of Maine contract forms.
  - 1.5 *Architectural Supplemental Instruction (ASI)*: A written instruction from the Architect for the purpose of clarification of the Contract Documents. An ASI does not alter the Contract Price or Contract Time. ASIs may be responses to RFIs and shall be issued by the Architect in a timely manner to avoid any negative impact on the Schedule of the Work.
  - 1.6 *Bid*: The Contractor's written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of the Work. A Bid may include bonds or other requirements. A base Bid is separate and distinct from Alternate Bids, being the only cost component necessary for the award of the contract, and representing the minimum amount of Work that is essential for the functioning of the Project.
  - 1.7 *Bid Bond*: The security designated in the Bid Documents, furnished by Bidders as a guaranty of good faith to enter into a contract with the Owner, should a contract be awarded to that Bidder.
  - 1.8 *Bidder*: Any business entity, individual or corporation that submits a bid for the performance of the work described in the Bid Documents, acting directly or through a duly authorized representative. See also *Responsive and Responsible Bidder*.
  - 1.9 *Bid Documents*: The drawings, procurement and contracting requirements, general requirements, and the written specifications -including all addenda, that a bidder is required to reference in the submission of a bid.
  - 1.10 *Bureau*: The State of Maine Bureau of General Services, or BGS, in the Department of Administrative and Financial Services.
  - 1.11 *Calendar days*: Consecutive days, as occurring on a calendar, taking into account each day of the week, month, year, and any religious, national or local holidays. Calendar days are used for changes in Contract Time.

**Definitions**

- 1.12 *Certificate of Substantial Completion*: A document developed by the Consultant that describes the final status of the Work and establishes the date that the Owner may use the facility for its intended purpose. The Certificate of Substantial Completion may also include a provisional list of items - a "punch list" - remaining to be completed by the Contractor. The Certificate of Substantial Completion identifies the date from which the project warranty period commences.
- 1.13 *Certificate of Occupancy*: A document developed by a local jurisdiction such as the Code Enforcement Officer that grants permission to the Owner to occupy a building.
- 1.14 *Change Order (CO)*: A document that modifies the contract and establishes the basis of a specific adjustment to the Contract Price or the Contract Time, or both. Change Orders may address correction of omissions, errors, and document discrepancies, or additional requirements. Change Orders should include all labor, materials and incidentals required to complete the work described. A Change Order is not valid until signed by the Contractor, Owner and Consultant and approved by the Bureau.
- 1.15 *Change Order Proposal (COP) (see also Proposal)*: Contract change proposed by the Contractor regarding the contract amount, requirements, or time. The Contractor implements the work of a COP after it is accepted by all parties. Accepted COPs are incorporated into the contract by Change Order.
- 1.16 *Clerk of the Works*: The authorized representative of the Consultant on the job site. Clerk of the Works is sometimes called the Architect's representative.
- 1.17 *Construction Change Directive (CCD)*: A written order prepared by the Consultant and signed by the Owner and Consultant, directing a change in the Work prior to final agreement with the Contractor on adjustment, if any, in the Contract Price or Contract Time, or both.
- 1.18 *Contract*: A written agreement between the Owner and the successful bidder which obligates the Contractor to perform the work specified in the Contract Documents and obligates the Owner to compensate the Contractor at the mutually accepted sum, rates or prices.
- 1.19 *Contract Bonds (also known as Payment and Performance Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.20 *Contract Documents*: The drawings and written specifications (including all addenda), Standard General Conditions, and the contract (including all Change Orders subsequently incorporated in the documents).
- 1.21 *Contract Expiration Date*: Date determined by the Owner as a deadline for internal management of contract accounts. This allows time after the Contract Final Completion Date for processing the final Requisition for Payment. The Contract Expiration Date does not directly relate to any contract obligation of the Contractor.
- 1.22 *Contract Final Completion Date*: Point of time when the Work is fully completed in compliance with the Contract Documents, as certified by the Consultant. Final payment to the Contractor is due upon Final Completion of the Project.



**Definitions**

- 1.23 *Contract Price*: The dollar amount of the construction contract, also called *Contract Sum*.
- 1.24 *Contract Time*: The designated duration of time to execute the Work of the contract, with a specific date for completion.
- 1.25 *Contractor*: Also called the "General Contractor" or "GC" the individual or entity undertaking the execution of the general contract work under the terms of the contract with the Owner, acting directly or through a duly authorized representative. The Contractor is responsible for the means, methods and materials utilized in the execution and completion of the Work.
- 1.26 *Consultant*: The Architect or Engineer acting as Professional-of-Record for the Project. The Consultant is responsible for the design of the Project.
- 1.27 *Drawings*: The graphic and pictorial portion of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.
- 1.28 *Engineer*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to "Consultant" in State of Maine contract forms.
- 1.29 *Filed Sub-bid*: The designated major Subcontractor's (or, in some cases, Contractor's) written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of a particular portion of the Work. A Filed Sub-bid may include bonds or other requirements.
- 1.30 *General Requirements*: The on-site overhead expense items the Contractor provides for the Project, typically including, but not limited to, building permits, construction supervision, Contract Bonds, insurance, field office, temporary utilities, rubbish removal, and site fencing. Overhead expenses of the Contractor's general operation are not included. Sometimes referred to as the Contractor's General Conditions.
- 1.31 *Owner*: The State agency which is represented by duly authorized individuals. The Owner is responsible for defining the scope of the Project and compensation to the Consultant and Contractor.
- 1.32 *Owner's Representative*: The individual or entity contracted by the Owner to be an advisor and information conduit regarding the Project.
- 1.33 *Overhead*: General and administrative expenses of the Contractor's principal and branch offices, including payroll costs and other compensation of Contractor employees, deductibles paid on any insurance policy, charges against the Contractor for delinquent payments, and costs related to the correction of defective work, and the Contractor's capital expenses, including interest on capital used for the work.
- 1.34 *Performance and Payment Bonds (also known as Contract Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.

**Definitions**

- 1.35 *Post-Bid Addendum*: Document issued by the Consultant that defines a potential Change Order prior to signing of the construction contract. The Post-Bid Addendum allows the Owner to negotiate contract changes with the Bidder submitting the lowest valid bid, only if the negotiated changes to the Bid Documents result in no change or no increase in the bid price.
- A Post-Bid Addendum may also be issued after a competitive construction Bid opening to those Bidders who submitted a Bid initially, for the purpose of rebidding the Project work without re-advertising.
- 1.36 *Project*: The construction project proposed by the Owner to be constructed according to the Contract Documents. The Project, a public improvement, may be tied logistically to other public improvements and other activities conducted by the Owner or other contractors.
- 1.37 *Proposal (see also Change Order Proposal)*: The Contractor's written offer submitted to the Owner for consideration containing a specified dollar amount or rate, for a specific scope of work, and including a schedule impact, if any. A proposal shall include all costs for overhead and profit. The Contractor implements the work of a Proposal after it is accepted by all parties. Accepted Proposals are incorporated into the contract by Change Order.
- 1.38 *Proposal Request (PR)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.39 *Punch List*: A document that identifies the items of work remaining to be done by the Contractor at the Close Out of a Project. The Punch List is created as a result of a final inspection of the work only after the Contractor attests that all of the Work is in its complete and permanent status.
- 1.40 *Request For Information (RFI)*: A Contractor's written request to the Consultant for clarification, definition or description of the Work. RFIs shall be presented by the Contractor in a timely manner to avoid any negative impact on the Schedule of the Work.
- 1.41 *Request For Proposal (RFP)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.42 *Requisition for Payment*: The document in which the Contractor certifies that the Work described is, to the best of the Contractor's knowledge, information and belief, complete and that all previous payments have been paid by the Contractor to Subcontractors and suppliers, and that the current requested payment is now due. See *Schedule of Values*.
- 1.43 *Responsive and Responsible Bidder*: A bidder who complies, when submitting a bid on a given project, with the following *responsive* standards, as required by the Bid Documents:
- submits specific qualifications to bid the project, if required;
  - attends mandatory pre-bid conferences, if required;
  - submits a bid prior to the close of the bid period;
  - submits a complete bid form;
  - submits a bid without indications of intent contrary to the stated requirements;
  - submits other materials and information, such as bid security, as required;
- and, meets the following minimums regarding these *responsible* standards:
- sustains a satisfactory record of project performance;
  - maintains a permanent place of business in a known physical location;

**Definitions**

possesses the financial means for short- and long-term operations;  
possesses the appropriate technical experience and capabilities;  
employs adequate personnel and subcontractor resources;  
maintains the equipment needed to perform the work;  
complies with the proposed implementation schedule;  
complies with the insurance and bonding requirements;  
provides post-construction warranty coverage;  
and other criteria which can be considered relevant to the contract.

- 1.44 *Retainage*: The amount, calculated at five percent (5%) of the contract value or a scheduled value, that the Owner shall withhold from the Contractor until the work or portion of work is declared substantially complete or otherwise accepted by the Owner. The Owner may, if requested, reduce the amount withheld if the Owner deems it desirable and prudent to do so. (See Title 5 M.R.S.A., Section 1746.)
- 1.45 *Sample*: A physical example provided by the Contractor which illustrates materials, equipment or workmanship and establishes standards by which the Work will be judged.
- 1.46 *Schedule of the Work*: The document prepared by the Contractor and approved by the Owner that specifies the dates on which the Contractor plans to begin and complete various parts of the Work, including dates on which information and approvals are required from the Owner.
- 1.47 *Schedule of Values*: The document prepared by the Contractor and approved by the Owner before the commencement of the Work that specifies the dollar values of discrete portions of the Work equal in sum to the contract amount. The Schedule of Values is used to document progress payments of the Work in regular (usually monthly) requisitions for payment. See *Requisition for Payment*.
- 1.48 *Shop Drawings*: The drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
- 1.49 *Specifications*: The portion of the Contract Documents consisting of the written requirements of the Work for materials, equipment, systems, standards, workmanship, and performance of related services.
- 1.50 *Subcontractor*: An individual or entity undertaking the execution of any part of the Work by virtue of a written agreement with the Contractor or any other Subcontractor. Also, an individual or entity retained by the Contractor or any other Subcontractor as an independent contractor to provide the labor, materials, equipment or services necessary to complete a specific portion of the Work.
- 1.51 *Substantial Completion Date*: Point of time when the Work or a designated portion of the Work is sufficiently complete in compliance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended purpose without unscheduled disruption. Substantial Completion is documented by the date of the Certificate of Substantial Completion signed by the Owner and the Contractor.
- 1.52 *Superintendent*: The representative of the Contractor on the job site, authorized by the Contractor to receive and fulfill instructions from the Consultant.

**Definitions**

- 1.53 *Surety*: The individual or entity that is legally bound with the Contractor and Subcontractor to insure the faithful performance of the contract and for the payment of the bills for labor, materials and equipment by the Contractor and Subcontractors.
- 1.54 *Work*: The construction and services, whether completed or partially completed, including all labor, materials, equipment and services provided or to be provided by the Contractor and Subcontractors to fulfill the requirements of the Project as described in the Contract Documents.

**00 72 13**  
**General Conditions**

**Table of Contents of this General Conditions Section**

1. Preconstruction Conference .....	2
2. Intent and Correlation of Contract Documents .....	2
3. Additional Drawings and Specifications .....	3
4. Ownership of Contract Documents .....	3
5. Permits, Laws, and Regulations .....	3
6. Taxes .....	4
7. Labor and Wages.....	4
8. Indemnification .....	5
9. Insurance Requirements .....	5
10. Contract Bonds.....	7
11. Patents and Royalties .....	7
12. Surveys, Layout of Work .....	7
13. Record of Documents.....	8
14. Allowances .....	8
15. Shop Drawings.....	8
16. Samples .....	8
17. Substitutions.....	9
18. Assignment of Contract.....	9
19. Separate Contracts.....	9
20. Subcontracts .....	10
21. Contractor-Subcontractor Relationship .....	10
22. Supervision of the Work .....	11
23. Observation of the Work .....	12
24. Consultant's Status .....	12
25. Management of the Premises .....	13
26. Safety and Security of the Premises .....	13
27. Changes in the Work .....	14
28. Correction of the Work .....	16
29. Owner's Right to do Work.....	16
30. Termination of Contract and Stop Work Action .....	17
31. Delays and Extension of Time .....	18
32. Payments to the Contractor .....	18
33. Payments Withheld .....	19
34. Liens.....	19
35. Workmanship .....	20
36. Close-out of the Work .....	20
37. Date of Completion and Liquidated Damages .....	21
38. Dispute Resolution .....	22

**00 72 13**  
**General Conditions**

**1. Preconstruction Conference**

- 1.1 The Contractor shall, upon acceptance of a contract and prior to commencing work, schedule a preconstruction conference with the Owner and Consultant. The purpose of this conference is as follows.
- 1.1.1 Introduce all parties who have a significant role in the Project, including:
- Owner (State agency or other contracting entity)
  - Owner's Representative
  - Consultant (Architect or Engineer)
  - Subconsultants
  - Clerk-of-the-works
  - Contractor (GC)
  - Superintendent
  - Subcontractors
  - Other State agencies
  - Construction testing company
  - Commissioning agent
  - Special Inspections agent
  - Bureau of General Services (BGS);
- 1.1.2 Review the responsibilities of each party;
- 1.1.3 Review any previously-identified special provisions of the Project;
- 1.1.4 Review the Schedule of the Work calendar submitted by the Contractor to be approved by the Owner and Consultant;
- 1.1.5 Review the Schedule of Values form submitted by the Contractor to be approved by the Owner and Consultant;
- 1.1.6 Establish routines for Shop Drawing approval, contract changes, requisitions, et cetera;
- 1.1.7 discuss jobsite issues;
- 1.1.8 Discuss Project close-out procedures;
- 1.1.9 Provide an opportunity for clarification of Contract Documents before work begins; and
- 1.1.10 Schedule regular meetings at appropriate intervals for the review of the progress of the Work.

**2. Intent and Correlation of Contract Documents**

- 2.1 The intent of the Contract Documents is to describe the complete Project. The Contract Documents consist of various components; each component complements the others. What is shown as a requirement by any one component shall be inferred as a requirement on all corresponding components.
- 2.2 The Contractor shall furnish all labor, equipment and materials, tools, transportation, insurance, services, supplies, operations and methods necessary for, and reasonably incidental to, the construction and completion of the Project. Any work that deviates from the Contract Documents which appears to be required by the exigencies of construction or by inconsistencies in the Contract Documents, will be determined by the Consultant and authorized in writing by the Consultant, Owner and the Bureau prior to execution. The Contractor shall be responsible for requesting clarifying information where the intent of the Contract Documents is uncertain.
- 2.3 The Contractor shall not utilize any apparent error or omission in the Contract Documents to the disadvantage of the Owner. The Contractor shall promptly notify the Consultant in writing of such errors or omissions. The Consultant shall make any

**00 72 13**  
**General Conditions**

corrections or clarifications necessary in such a situation to document the true intent of the Contract Documents.

**3. Additional Drawings and Specifications**

- 3.1 Upon the written request of the Contractor, the Owner shall provide, at no expense to the Contractor, up to five sets of printed Drawings and Specifications for the execution of the Work.
- 3.2 The Consultant shall promptly furnish to the Contractor revised Drawings and Specifications, for the area of the documents where those revisions apply, when corrections or clarifications are made by the Consultant. All such information shall be consistent with, and reasonably inferred from, the Contract Documents. The Contractor shall do no work without the proper Drawings and Specifications.

**4. Ownership of Contract Documents**

- 4.1 The designs represented on the Contract Documents are the property of the Consultant. The Drawings and Specifications shall not be used on other work without consent of the Consultant.

**5. Permits, Laws, and Regulations**

- 5.1 The Owner is responsible for obtaining any zoning approvals or other similar local project approvals necessary to complete the Work, unless otherwise specified in the Contract Documents.
- 5.2 The Owner is responsible for obtaining Maine Department of Environmental Protection, Maine Department of Transportation, or other similar state government project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.3 The Owner is responsible for obtaining any federal agency project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.4 The Owner is responsible for obtaining all easements for permanent structures or permanent changes in existing facilities.
- 5.5 The Contractor is responsible for obtaining and paying for all permits and licenses necessary for the implementation of the Work. The Contractor shall notify the Owner of any delays, variance or restrictions that may result from the issuing of permits and licenses.
- 5.6 The Contractor shall comply with all ordinances, laws, rules and regulations and make all required notices bearing on the implementation of the Work. In the event the Contractor observes disagreement between the Drawings and Specifications and any ordinances, laws, rules and regulations, the Contractor shall promptly notify the Consultant in writing. Any necessary changes shall be made as provided in the contract for changes in the work. The Contractor shall not perform any work knowing it to be contrary to such ordinances, laws, rules and regulations.

**00 72 13**  
**General Conditions**

- 5.7 The Contractor shall comply with local, state and federal regulations regarding construction safety and all other aspects of the Work.
- 5.8 The Contractor shall comply with the Maine Code of Fair Practices and Affirmative Action, 5 M.R.S. §784 (2).
6. Taxes
- 6.1 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.
- 6.2 Section 1760 further provides in subsection 61 that sales to a construction contractor or its subcontractor of tangible personal property that is to be physically incorporated in, and become a permanent part of, real property for sale to or owned by the Owner, are exempt from Maine State sales and use taxes. Tangible personal property is defined in 36 M.R.S. §1752 (17).
- 6.3 The Contractor may contact Maine Revenue Services, 24 State House Station, Augusta, Maine 04333 for guidance on tax exempt regulations authorized by 36 M.R.S. §1760 and detailed in Rule 302 (18-125 CMR 302).
7. Labor and Wages
- 7.1 The Contractor shall conform to the labor laws of the State of Maine, and all other laws, ordinances, and legal requirements affecting the work in Maine.
- 7.2 The Consultant shall include a wage determination document prepared by the Maine Department of Labor in the Contract Documents for state-funded contracts in excess of \$50,000. The document shows the minimum wages required to be paid to each category of labor employed on the project.
- 7.3 On projects requiring a Maine wage determination, the Contractor shall submit monthly payroll records to the Owner ("the contracting agency") showing the name and occupation of all workers and all independent contractors employed on the project. The monthly submission must also include the Contractor's company name, the title of the project, hours worked, hourly rate or other method of remuneration, and the actual wages or other compensation paid to each person.
- 7.4 The Contractor shall not reveal, in the payroll records submitted to the Owner, personal information regarding workers and independent contractors, other than the information described above. Such information shall not include Social Security number, employee identification number, or employee address or phone number, for example.
- 7.5 The Contractor shall conform to Maine statute (39-A M.R.S. §105-A (6)) by providing to the Workers' Compensation Board a list of all subcontractors and independent contractors on the job site and a record of the entity to whom that subcontractor or independent contractor is directly contracted and by whom that subcontractor or independent contractor is insured for workers' compensation purposes.



**00 72 13**  
**General Conditions**

- 7.6 The Contractor shall enforce strict discipline and good order among their employees at all times, and shall not employ any person unfit or unskilled to do the work assigned to them.
- 7.7 The Contractor shall promptly pay all employees when their compensation is due, shall promptly pay all others who have billed and are due for materials, supplies and services used in the Work, and shall promptly pay all others who have billed and are due for insurance, workers compensation coverage, federal and state unemployment compensation, and Social Security charges pertaining to this Project. Before final payments are made, the Contractor shall furnish to the Owner affidavits that all such payments described above have been made.
- 7.8 The Contractor may contact the Maine Department of Labor, 54 State House Station, Augusta, Maine 04333 for guidance on labor issues.
- 7.9 The Contractor may contact the Maine Workers' Compensation Board, 27 State House Station, Augusta, Maine 04333 for guidance on workers' compensation issues.

**8. Indemnification**

- 8.1 The Contractor shall indemnify and hold harmless the Owner and its officers and employees from and against any and all damages, liabilities, and costs, including reasonable attorney's fees, and defense costs, for any and all injuries to persons or property, including claims for violation of intellectual property rights, to the extent caused by the negligent acts or omissions of the Contractor, its employees, agents, officers or subcontractors in the performance of work under this Agreement. The Contractor shall not be liable for claims to the extent caused by the negligent acts or omissions of the Owner or for actions taken in reasonable reliance on written instructions of the Owner.
- 8.2 The Contractor shall notify the Owner promptly of all claims arising out of the performance of work under this Agreement by the Contractor, its employees or agents, officers or subcontractors.
- 8.3 This indemnity provision shall survive the termination of the Agreement, completion of the project or the expiration of the term of the Agreement.

**9. Insurance Requirements**

- 9.1 The Contractor shall provide, with each original of the signed Contract, an insurance certificate or certificates acceptable to the Owner and BGS. The Contractor shall submit insurance certificates to the Owner and BGS at the commencement of this Contract and at policy renewal or revision dates. The certificates shall identify the project name and BGS project number, and shall name the Owner as certificate holder and as additional insured for general liability and automobile liability coverages. The submitted forms shall contain a provision that coverage afforded under the insurance policies will not be canceled or materially changed unless at least ten days prior written notice by registered letter has been given to the Owner and BGS.

**General Conditions**

- 9.2 The Owner does not warrant or represent that the insurance required herein constitutes an insurance portfolio which adequately addresses all risks faced by the Contractor or its Subcontractors. The Contractor is responsible for the existence, extent and adequacy of insurance prior to commencement of work. The Contractor shall not allow any Subcontractor to commence work until all similar insurance required of the Subcontractor has been confirmed by the Contractor.
- 9.3 The Contractor shall procure and maintain primary insurance for the duration of the Project and, if written on a Claims-Made basis, shall also procure and maintain Extended Reporting Period (ERP) insurance for the period of time that any claims could be brought. The Contractor shall ensure that all Subcontractors they engage or employ will procure and maintain similar insurance in form and amount acceptable to the Owner and BGS. At a minimum, the insurance shall be of the types and limits set forth herein protecting the Contractor from claims which may result from the Contractor's execution of the Work, whether such execution be by the Contractor or by those employed by the Contractor or by those for whose acts they may be liable. All required insurance coverages shall be placed with carriers authorized to conduct business in the State of Maine by the Maine Bureau of Insurance.
- 9.3.1 The Contractor shall have Workers' Compensation insurance for all employees on the Project site in accordance with the requirements of the Workers' Compensation law of the State of Maine. Minimum acceptable limits for Employer's Liability are:
- |                                |                         |
|--------------------------------|-------------------------|
| Bodily Injury by Accident..... | \$500,000               |
| Bodily Injury by Disease ..... | \$500,000 Each Employee |
| Bodily Injury by Disease ..... | \$500,000 Policy Limit  |
- 9.3.2 The Contractor shall have Commercial General Liability insurance providing coverage for bodily injury and property damage liability for all hazards of the Project including premise and operations, products and completed operations, contractual, and personal injury liabilities. The policy shall include collapse and underground coverage as well as explosion coverage if explosion hazards exist. Aggregate limits shall apply on a location or project basis. Minimum acceptable limits are:
- |   |             |
|---|-------------|
| General aggregate limit.....                      | \$2,000,000 |
| Products and completed operations aggregate ..... | \$1,000,000 |
| Each occurrence limit .....                       | \$1,000,000 |
| Personal injury aggregate.....                    | \$1,000,000 |
- 9.3.3 The Contractor shall have Automobile Liability insurance against claims for bodily injury, death or property damage resulting from the maintenance, ownership or use of all owned, non-owned and hired automobiles, trucks and trailers. Minimum acceptable limit is:
- |                                |           |
|--------------------------------|-----------|
| Any one accident or loss ..... | \$500,000 |
|--------------------------------|-----------|
- 9.3.4 For the portion of a project which is new construction, the Contractor shall procure and maintain Builder's Risk insurance naming the Owner, Contractor, and any Subcontractor as insureds as their interest may appear. Covered causes of loss form shall be all Risks of Direct Physical Loss, endorsed to include flood, earthquake, transit and sprinkler leakage where sprinkler coverage is applicable. Unless specifically authorized in writing by the Owner, the limit of insurance shall not be less than the initial contract amount, for the portion of the project which is new construction, and coverage shall apply during the entire contract period and until the work is accepted by the Owner.

**00 72 13**  
**General Conditions**

- 9.3.5 The Contractor shall have Owner's Protective Liability insurance for contract values \$50,000 and above, naming the Owner as the Named Insured. Minimum acceptable limits are:

General aggregate limit.....\$2,000,000  
Each occurrence limit .....\$1,000,000

**10. Contract Bonds**

- 10.1 When noted as required in the Bid Documents, the Contractor shall provide to the Owner a Performance Bond and a Payment Bond, or "contract bonds", upon execution of the contract. Each bond value shall be for the full amount of the contract and issued by a surety company authorized to do business in the State of Maine as approved by the Owner. The bonds shall be executed on the forms furnished in the Bid Documents. The bonds shall allow for any subsequent additions or deductions of the contract.
- 10.2 The contract bonds shall continue in effect for one year after final acceptance of the contract to protect the Owner's interest in connection with the one year guarantee of workmanship and materials and to assure settlement of claims for the payment of all bills for labor, materials and equipment by the Contractor.

**11. Patents and Royalties**

- 11.1 The Contractor shall, for all time, secure for the Owner the free and undisputed right to the use of any patented articles or methods used in the Work. The expense of defending any suits for infringement or alleged infringement of such patents shall be borne by the Contractor. Awards made regarding patent suits shall be paid by the Contractor. The Contractor shall hold the Owner harmless regarding patent suits that may arise due to installations made by the Contractor, and to any awards made as a result of such suits.
- 11.2 Any royalty payments related to the work done by the Contractor for the Project shall be borne by the Contractor. The Contractor shall hold the Owner harmless regarding any royalty payments that may arise due to installations made by the Contractor.

**12. Surveys, Layout of Work**

- 12.1 The Owner shall furnish all property surveys unless otherwise specified.
- 12.2 The Contractor is responsible for correctly staking out the Work on the site. The Contractor shall employ a competent surveyor to position all construction on the site. The surveyor shall run the axis lines, establish correct datum points and check each line and point on the site to insure their accuracy. All such lines and points shall be carefully preserved throughout the construction.
- 12.3 The Contractor shall lay out all work from dimensions given on the Drawings. The Contractor shall take measurements and verify dimensions of any existing work that affects the Work or to which the Work is to be fitted. The Contractor is solely responsible for the accuracy of all measurements. The Contractor shall verify all grades, lines, levels, elevations and dimensions shown on the Drawings and report any errors or inconsistencies to the Consultant prior to commencing work.

**00 72 13**  
**General Conditions**

**13. Record of Documents**

- 13.1 The Contractor shall maintain one complete set of Contract Documents on the jobsite, in good order and current status, for access by the Owner and Consultant.
- 13.2 The Contractor shall maintain, continuously updated, complete records of Requests for Information, Architectural Supplemental Instructions (or equivalent), Information Bulletins, supplemental sketches, Change Order Proposals, Change Orders, Shop Drawings, testing reports, et cetera, for access by the Owner and Consultant.

**14. Allowances**

- 14.1 The Contract Price shall include all allowances described in the Contract Documents. The Contractor shall include all overhead and profit necessary to implement each allowance in their Contract Price.
- 14.2 The Contractor shall not be required to employ parties for allowance work against whom the Contractor has a reasonable objection. In such a case, the Contractor shall notify the Owner in writing of their position and shall propose an alternative party to complete the work of the allowance.

**15. Shop Drawings**

- 15.1 The Contractor shall administer Shop Drawings prepared by the Contractor, Subcontractors, suppliers or others to conform to the approved Schedule of the Work. The Contractor shall verify all field measurements, check and authorize all Shop Drawings and schedules required by the Work. The Contractor is the responsible party and contact for the Contractor's work as well as that of Subcontractors, suppliers or others who provide Shop Drawings.
- 15.2 The Consultant shall review and acknowledge Shop Drawings, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents.
- 15.3 The Contractor shall provide monthly updated logs containing: requests for information, information bulletins, supplemental instructions, supplemental sketches, change order proposals, change orders, submittals, testing and deficiencies.
- 15.4 The Contractor shall make any corrections required by the Consultant, and shall submit a quantity of corrected copies as may be needed. The acceptance of Shop Drawings or schedules by the Consultant shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications, unless the Contractor has called such deviations to the attention of the Consultant at the time of submission and secured the Consultant's written approval. The acceptance of Shop Drawings or schedules by the Consultant does not relieve the Contractor from responsibility for errors in Shop Drawings or schedules.

**16. Samples**

- 16.1 The Contractor shall furnish for approval, with reasonable promptness, all samples as directed by the Consultant. The Consultant shall review and approve such samples, with

**00 72 13**  
**General Conditions**

reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents. The subsequent work shall be in accord with the approved samples.

**17. Substitutions**

- 17.1 The Contractor shall furnish items and materials described in the Contract Documents. If the item or material specified describes a proprietary product, or uses the name of a manufacturer, the term “or approved equal” shall be implied, if it is not included in the text. The specific item or material specified establishes a minimum standard for the general design, level of quality, type, function, durability, efficiency, reliability, compatibility, warranty coverage, installation factors and required maintenance. The Drawing or written Specification shall not be construed to exclude other manufacturers products of comparable design, quality, and efficiency.
- 17.2 The Contractor may submit detailed information about a proposed substitution to the Consultant for consideration. Particular models of items and particular materials which the Contractor asserts to be equal to the items and materials identified in the Contract Documents shall be allowed only with written approval by the Consultant. The request for substitution shall include a cost comparison and a reason or reasons for the substitution.
- 17.3 The Consultant may request additional information about the proposed substitution. The approval or rejection of a proposed substitution may be based on timeliness of the request, source of the information, the considerations of minimum standards described above, or other considerations. The Consultant should briefly state the rationale for the decision. The decision shall be considered final.
- 17.4 The duration of a substitution review process can not be the basis for a claim for delay in the Schedule of the Work.

**18. Assignment of Contract**

- 18.1 The Contractor shall not assign or sublet the contract as a whole without the written consent of the Owner. The Contractor shall not assign any money due to the Contractor without the written consent of the Owner.

**19. Separate Contracts**

- 19.1 The Owner reserves the right to create other contracts in connection with this Project using similar General Conditions. The Contractor shall allow the Owner's other contractors reasonable opportunity for the delivery and storage of materials and the execution of their work. The Contractor shall coordinate and properly connect the Work of all contractors.
- 19.2 The Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in work of the Owner's other contractors that impacts the proper execution or results of the Contractor. The Contractor's failure to observe or report any deficiencies constitutes an acceptance of the Owner's other contractors work as suitable for the

**00 72 13**  
**General Conditions**

interface of the Contractor's work, except for latent deficiencies in the Owner's other contractors work.

- 19.3 Similarly, the Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in their own work that would impact the proper execution or results of the Owner's other contractors.
- 19.4 The Contractor shall report to the Consultant and Owner any conflicts or claims for damages with the Owner's other contractors and settle such conflicts or claims for damages by mutual agreement or arbitration, if necessary, at no expense to the Owner.
- 19.5 In the event the Owner's other contractors sue the Owner regarding any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend such proceedings at the Contractor's expense. The Contractor shall pay or satisfy any judgment that may arise against the Owner, and pay all other costs incurred.

**20. Subcontracts**

- 20.1 The Contractor shall not subcontract any part of this contract without the written permission of the Owner.
- 20.2 The Contractor shall submit a complete list of named Subcontractors and material suppliers to the Consultant and Owner for approval by the Owner prior to commencing work. The Subcontractors named shall be reputable companies of recognized standing with a record of satisfactory work.
- 20.3 The Contractor shall not employ any Subcontractor or use any material until they have been approved, or where there is reason to believe the resulting work will not comply with the Contract Documents.
- 20.4 The Contractor, not the Owner, is as fully responsible for the acts and omissions of Subcontractors and of persons employed by them, as the Contractor is for the acts and omissions of persons directly or indirectly employed by the Contractor.
- 20.5 Neither the Contract Documents nor any Contractor-Subcontractor contract shall indicate, infer or create any direct contractual relationship between any Subcontractor and the Owner.

**21. Contractor-Subcontractor Relationship**

- 21.1 The Contractor shall be bound to the Subcontractor by all the obligations in the Contract Documents that bind the Contractor to the Owner.
- 21.2 The Contractor shall pay the Subcontractor, in proportion to the dollar value of the work completed and requisitioned by the Subcontractor, the approved dollar amount allowed to the Contractor no more than seven days after receipt of payment from the Owner.
- 21.3 The Contractor shall pay the Subcontractor accordingly if the Contract Documents or the subcontract provide for earlier or larger payments than described in the provision above.

**00 72 13**  
**General Conditions**

- 21.4 The Contractor shall pay the Subcontractor for completed and requisitioned subcontract work, less retainage, no more than seven days after receipt of payment from the Owner for the Contractor's approved Requisition for Payment, even if the Consultant fails to certify a portion of the Requisition for Payment for a cause not the fault of the Subcontractor.
- 21.5 The Contractor shall not make a claim for liquidated damages or penalty for delay in any amount in excess of amounts that are specified by the subcontract.
- 21.6 The Contractor shall not make a claim for services rendered or materials furnished by the Subcontractor unless written notice is given by the Contractor to the Subcontractor within ten calendar days of the day in which the claim originated.
- 21.7 The Contractor shall give the Subcontractor an opportunity to present and to submit evidence in any progress conference or disputes involving subcontract work.
- 21.8 The Contractor shall pay the Subcontractor a just share of any fire insurance payment received by the Contractor.
- 21.9 The Subcontractor shall be bound to the Contractor by the terms of the Contract Documents and assumes toward the Contractor all the obligations and responsibilities that the Contractor, by those documents, assumes toward the Owner.
- 21.10 The Subcontractor shall submit applications for payment to the Contractor in such reasonable time as to enable the Contractor to apply for payment as specified.
- 21.11 The Subcontractor shall make any claims for extra cost, extensions of time or damages, to the Contractor in the manner provided in these General Conditions for like claims by the Contractor to the Owner, except that the time for the Subcontractor to make claims for extra cost is seven calendar days after the receipt of Consultant's instructions.

**22. Supervision of the Work**

- 22.1 During all stages of the Work the Contractor shall have a competent superintendent, with any necessary assistant superintendents, overseeing the project. The superintendent shall not be reassigned without the consent of the Owner unless a superintendent ceases to be employed by the Contractor due to unsatisfactory performance.
- 22.2 The superintendent represents the Contractor on the jobsite. Directives given by the Consultant or Owner to the superintendent shall be as binding as if given directly to the Contractor's main office. All important directives shall be confirmed in writing to the Contractor. The Consultant and Owner are not responsible for the acts or omissions of the superintendent or assistant superintendents.
- 22.3 The Contractor shall provide supervision of the Work equal to the industry's highest standard of care. The superintendent shall carefully study and compare all Contract Documents and promptly report any error, inconsistency or omission discovered to the Consultant. The Contractor may not necessarily be held liable for damages resulting directly from any error, inconsistency or omission in the Contract Documents or other instructions by the Consultant that was not revealed by the superintendent in a timely way.

**00 72 13**  
**General Conditions**

**23. Observation of the Work**

- 23.1 The Contractor shall allow the Owner, the Consultant and the Bureau continuous access to the site for the purpose of observation of the progress of the work. All necessary safeguards and accommodations for such observations shall be provided by the Contractor.
- 23.2 The Contractor shall coordinate all required testing, approval or demonstration of the Work. The Contractor shall give sufficient notice to the appropriate parties of readiness for testing, inspection or examination.
- 23.3 The Contractor shall schedule inspections and obtain all required certificates of inspection for inspections by a party other than the Consultant.
- 23.4 The Consultant shall make all scheduled observations promptly, prior to the work being concealed or buried by the Contractor. If approval of the Work is required of the Consultant, the Contractor shall notify the Consultant of the construction schedule in this regard. Work concealed or buried prior to the Consultant's approval may need to be uncovered at the Contractor's expense.
- 23.5 The Consultant may order reexamination of questioned work, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to conform to the Contract Documents, the Owner shall pay the expense of the reexamination and remedial work. If the work is found to not conform to the Contract Documents, the Contractor shall pay the expense, unless the defect in the work was caused by the Owner's Contractor, whose responsibility the reexamination expense becomes.
- 23.6 The Bureau shall periodically observe the Work during the course of construction and make recommendations to the Contractor or Consultant as necessary. Such recommendations shall be considered and implemented through the usual means for changes to the Work.

**24. Consultant's Status**

- 24.1 The Consultant represents the Owner during the construction period, and observes the work in progress on behalf of the Owner. The Consultant has authority to act on behalf of the Owner only to the extent expressly provided by the Contract Documents or otherwise demonstrated to the Contractor. The Consultant has authority to stop the work whenever such an action is necessary, in the Consultant's reasonable opinion, to ensure the proper execution of the contract.
- 24.2 The Consultant is the interpreter of the conditions of the contract and the judge of its performance. The Consultant shall favor neither the Owner nor the Contractor, but shall use the Consultant's powers under the contract to enforce faithful performance by both parties.
- 24.3 In the event of the termination of the Consultant's employment on the project prior to completion of the work, the Owner shall appoint a capable and reputable replacement. The status of the new Consultant relative to this contract shall be that of the former Consultant.



**00 72 13**  
**General Conditions**

**25. Management of the Premises**

- 25.1 The Contractor shall place equipment and materials, and conduct activities on the premises in a manner that does not unreasonably hinder site circulation, environmental stability, or any long term effect. Likewise, the Consultant's directions shall not cause the use of premises to be impeded for the Contractor or Owner.
- 25.2 The Contractor shall not use the premises for any purpose other than that which is directly related to the scope of work. The Owner shall not use the premises for any purpose incompatible with the proposed work simultaneous to the work of the Contractor.
- 25.3 The Contractor shall enforce the Consultant's instructions regarding information posted on the premises such as signage and advertisements, as well as activities conducted on the premises such as fires, and smoking.
- 25.4 The Owner may occupy any part of the Project that is completed with the written consent of the Contractor, and without prejudice to any of the rights of the Owner or Contractor. Such use or occupancy shall not, in and of itself, be construed as a final acceptance of any work or materials.

**26. Safety and Security of the Premises**

- 26.1 The Contractor shall designate, and make known to the Consultant and the Owner, a safety officer whose duty is the prevention of accidents on the site.
- 26.2 The Contractor shall continuously maintain security on the premises and protect from unreasonable occasion of injury all people authorized to be on the job site. The Contractor shall also effectively protect the property and adjacent properties from damage or loss.
- 26.3 The Contractor shall take all necessary precautions to ensure the safety of workers and others on and adjacent to the site, abiding by applicable local, state and federal safety regulations. The Contractor shall erect and continuously maintain safeguards for the protection of workers and others, and shall post signs and other warnings regarding hazards associated with the construction process, such as protruding fasteners, moving equipment, trenches and holes, scaffolding, window, door or stair openings, and falling materials.
- 26.4 The Contractor shall restore the premises to conditions that existed prior to the start of the project at areas not intended to be altered according to the Contract Documents.
- 26.5 The Contractor shall protect existing utilities and exercise care working in the vicinity of utilities shown in the Drawings and Specifications or otherwise located by the Contractor.
- 26.6 The Contractor shall protect from damage existing trees and other significant plantings and landscape features of the site which will remain a permanent part of the site. If necessary or indicated in the Contract Documents, tree trunks shall be boxed and barriers erected to prevent damage to tree branches or roots.

**00 72 13**  
**General Conditions**

- 26.7 The Contractor shall repair or replace damage to the Work caused by the Contractor's or Subcontractor's forces, including that which is reasonably protected, at the expense of the responsible party.
- 26.8 The Contractor shall not load, or allow to be loaded, any part of the Project with a force which imperils personal or structural safety. The Consultant may consult with the Contractor on such means and methods of construction, however, the ultimate responsibility lies with the Contractor.
- 26.9 The Contractor shall not jeopardize any work in place with subsequent construction activities such as blasting, drilling, excavating, cutting, patching or altering work. The Consultant must approve altering any structural components of the project. The Contractor shall supervise all construction activities carried out by others on site to ensure that the work is neatly done and in a manner that will not endanger the structure or the component parts.
- 26.10 The Contractor may act with their sole discretion in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Contractor may negotiate with the Owner for compensation for expenses due to such emergency work.
- 26.11 The Contractor and Subcontractors shall have no responsibility for the identification, discovery, presence, handling, removal or disposal of, or exposure of persons to, hazardous materials in any form at the project site. The Contractor shall avoid disruption of any hazardous materials or toxic substances at the project site and promptly notify the Owner in writing on the occasion of such a discovery.
- 26.12 The Contractor shall keep the premises free of any unsafe accumulation of waste materials caused by the work. The Contractor shall regularly keep the spaces "broom clean". See the Close-out of the Work provisions of this section regarding cleaning at the completion of the project.
27. Changes in the Work
- 27.1 The Contractor shall not proceed with extra work without an approved Change Order or Construction Change Directive. A Change Order which has been properly signed by all parties shall become a part of the contract.
- 27.2 A Change Order is the usual document for directing changes in the Work. In certain circumstances, however, the Owner may utilize a Construction Change Directive to direct the Contractor to perform changes in the Work that are generally consistent with the scope of the project. The Owner shall use a Construction Change Directive only when the normal process for approving changes to the Work has failed to the detriment of the Project, or when agreement on the terms of a Change Order cannot be met, or when an urgent situation requires, in the Owner's judgment, prompt action by the Contractor.
- 27.3 The Consultant shall prepare the Construction Change Directive representing a complete scope of work, with proposed Contract Price and Contract Time revisions, if any, clearly stated.

**00 72 13**  
**General Conditions**

- 27.4 The Contractor shall promptly carry out a Construction Change Directive which has been signed by the Owner and the Consultant. Work thus completed by the Contractor constitutes the basis for a Change Order. Changes in the Contract Price and Contract Time shall be as defined in the Construction Change Directive unless subsequently negotiated with some other terms.
- 27.5 The method of determining the dollar value of extra work shall be by:
- .1 an estimate of the Contractor accepted by Owner as a lump sum, or
  - .2 unit prices named in the contract or subsequently agreed upon, or
  - .3 cost plus a designated percentage, or
  - .4 cost plus a fixed fee.
- 27.6 The Contractor shall determine the dollar value of the extra work for both the lump sum and cost plus designated percentage methods so as not to exceed the following rates. The rates include all overhead and profit expenses.
- .1 Contractor - for any work performed by the Contractor's own forces, up to 20% of the cost;
  - .2 Subcontractor - for work performed by Subcontractor's own forces, up to 20% of the cost;
  - .3 Contractor - for work performed by Contractor's Subcontractor, up to 10% of the amount due the Subcontractor.
- 27.7 The Contractor shall keep and provide records as needed or directed for the cost plus designated percentage method. The Consultant shall review and certify the appropriate amount which includes the Contractor's overhead and profit. The Owner shall make payments based on the Consultant's certificate.
- 27.8 Cost reflected in Change Orders shall be limited to the following: cost of materials, cost of delivery, cost of labor (including Social Security, pension, Workers' Compensation insurance, and unemployment insurance), and cost of rental of power tools and equipment. Labor cost may include a pro-ratio share of a foreman's time only in the case of an extension of contract time granted due to the Change Order.
- 27.9 Overhead reflected in Change Orders shall be limited to the following: bond premium, supervision, wages of clerks, time keepers, and watchmen, small tools, incidental expenses, general office expenses, and all other overhead expenses directly related to the Change Order.
- 27.10 The Contractor shall provide credit to the Owner for labor, materials, equipment and other costs but not overhead and profit expenses for those Change Order items that result in a net value of credit to the contract.
- 27.11 The Owner may change the scope of work of the Project without invalidating the contract. The Owner shall notify the Contractor of a change of the scope of work for the Owner's Contractors, which may affect the work of this Contractor, without invalidating the contract. Change Orders for extension of the time caused by such changes shall be developed at the time of directing the change in scope of work.
- 27.12 The Consultant may order minor changes in the Work, not involving extra cost, which is consistent with the intent of the design or project.

**00 72 13**  
**General Conditions**

- 27.13 The Contractor shall immediately give written notification to the Consultant of latent conditions discovered at the site which materially differ from those represented in the Drawings or Specifications, and which may eventually result in a change in the scope of work. The Contractor shall suspend work until receiving direction from the Consultant. The Consultant shall promptly investigate the conditions and respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the discovered conditions warrant a Change Order.
- 27.14 The Contractor shall, within ten calendar days of receipt of the information, give written notification to the Consultant if the Contractor claims that instructions by the Consultant will constitute extra cost not accounted for by Change Order or otherwise under the contract. The Consultant shall promptly respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the Contractor's claim warrants a Change Order.
28. Correction of the Work
- 28.1 The Contractor shall promptly remove from the premises all work the Consultant declares is non-conforming to the contract. The Contractor shall replace the work properly at no expense to the Owner. The Contractor is also responsible for the expenses of others whose work was damaged or destroyed by such remedial work.
- 28.2 The Owner may elect to remove non-conforming work if it is not removed by the Contractor within a reasonable time, that time defined in a written notice from the Consultant. The Owner may elect to store removed non-conforming work not removed by the Contractor at the Contractor's expense. The Owner may, with ten days written notice, dispose of materials which the Contractor does not remove. The Owner may sell the materials and apply the net proceeds, after deducting all expenses, to the costs that should have been borne by the Contractor.
- 28.3 The Contractor shall remedy any defects due to faulty materials or workmanship and pay for any related damage to other work which appears within a period of one year from the date of substantial completion, and in accord with the terms of any guarantees provided in the contract. The Owner shall promptly give notice of observed defects to the Contractor and Consultant. The Consultant shall determine the status of all claimed defects. The Contractor shall perform all remedial work without unjustifiable delay in either the initial response or the corrective action.
- 28.4 The Consultant may authorize, after a reasonable notification to the Contractor, an equitable deduction from the contract amount in lieu of the Contractor correcting non-conforming or defective work.
29. Owner's Right to do Work
- 29.1 The Owner may, using other contractors, correct deficiencies attributable to the Contractor, or complete unfinished work. Such action shall take place only after giving the Contractor three days written notice, and provided the Consultant approves of the

**00 72 13**  
**General Conditions**

- proposed course of action as an appropriate remedy. The Owner may then deduct the cost of the remedial work from the amount due the Contractor.
- 29.2 The Owner may act with their sole discretion when the Contractor is unable to take action in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Owner shall inform the Contractor of the emergency work performed, particularly where it may affect the work of the Contractor.
30. Termination of Contract and Stop Work Action
- 30.1 The Owner may, owing to a certificate of the Consultant indicating that sufficient cause exists to justify such action, without prejudice to any other right or remedy and after giving the Contractor and the Contractor's surety seven days written notice, terminate the employment of the Contractor. At that time the Owner may take possession of the premises and of all materials, tools and appliances on the premises and finish the work by whatever method the Owner may deem expedient. Cause for such action by the Owner includes:
- .1 the contractor is adjudged bankrupt, or makes a general assignment for the benefit of its creditors, or
  - .2 a receiver is appointed due to the Contractor's insolvency, or
  - .3 the Contractor persistently or repeatedly refuses or fails to provide enough properly skilled workers or proper materials, or
  - .4 the Contractor fails to make prompt payment to Subcontractors or suppliers of materials or labor, or
  - .5 the Contractor persistently disregards laws, ordinances or the instructions of the Consultant, or is otherwise found guilty of a substantial violation of a provision of the Contract Documents.
- 30.2 The Contractor is not entitled, as a consequence of the termination of the employment of the Contractor as described above, to receive any further payment until the Work is finished. If the unpaid balance of the contract amount exceeds the expense of finishing the Work, including compensation for additional architectural, managerial and administrative services, such balance shall be paid to the Contractor. If the expense of finishing the Work exceeds the unpaid balance, the Contractor shall pay the difference to the Owner. The Consultant shall certify the expense incurred by the Contractor's default. This obligation for payment shall continue to exist after termination of the contract.
- 30.3 The Contractor may, if the Work is stopped by order of any court or other public authority for a period of thirty consecutive days, and through no act or fault of the Contractor or of anyone employed by the Contractor, with seven days written notice to the Owner and the Consultant, terminate this contract. The Contractor may then recover from the Owner payment for all work executed, any proven loss and reasonable profit and damage.
- 30.4 The Contractor may, if the Consultant fails to issue a certificate for payment within seven days after the Contractor's formal request for payment, through no fault of the Contractor, or if the Owner fails to pay to the Contractor within 30 days after submission of any sum certified by the Consultant, with seven days written notice to the Owner and the Consultant, stop the Work or terminate this Contract.

**00 72 13**  
**General Conditions**

**31. Delays and Extension of Time**

- 31.1 The completion date of the contract shall be extended if the work is delayed by changes ordered in the work which have approved time extensions, or by an act or neglect of the Owner, the Consultant, or the Owner's Contractor, or by strikes, lockouts, fire, flooding, unusual delay in transportation, unavoidable casualties, or by other causes beyond the Contractor's control. The Consultant shall determine the status of all claimed causes.
- 31.2 The contract shall not be extended for delay occurring more than seven calendar days before the Contractor's claim made in writing to the Consultant. In case of a continuing cause of delay, only one claim is necessary.
- 31.3 The contract shall not be extended due to failure of the Consultant to furnish drawings if no schedule or agreement is made between the Contractor and the Consultant indicating the dates which drawings shall be furnished and fourteen calendar days has passed after said date for such drawings.
- 31.4 This article does not exclude the recovery of damages for delay by either party under other provisions in the Contract Document.

**32. Payments to the Contractor**

- 32.1 As noted under *Preconstruction Conference* in this section, the Contractor shall submit a Schedule of Values form, before the first application for payment, for approval by the Owner and Consultant. The Consultant may direct the Contractor to provide evidence that supports the correctness of the form. The approved Schedule of Values shall be used as a basis for payments.
- 32.2 The Contractor shall submit an application for each payment ("Requisition for Payment") on a form approved by the Owner and Consultant. The Consultant may require receipts or other documents showing the Contractor's payments for materials and labor, including payments to Subcontractors.
- 32.3 The Contractor shall submit Requisitions for Payment as the work progresses not more frequently than once each month, unless the Owner approves a more frequent interval due to unusual circumstances. The Requisition for Payment is based on the proportionate quantities of the various classes of work completed or incorporated in the Work, in agreement with the actual progress of the Work and the dollar value indicated in the Schedule of Values.
- 32.4 The Consultant shall verify and certify each Requisition for Payment which appears to be complete and correct prior to payment being made by the Owner. The Consultant may certify an appropriate amount for materials not incorporated in the Work which have been delivered and suitably stored at the site. The Contractor shall submit bills of sale, insurance certificates, or other such documents that will adequately protect the Owner's interests prior to payments being certified.
- 32.5 In the event any materials delivered but not yet incorporated in the Work have been included in a certified Requisition for Payment with payment made, and said materials thereafter are damaged, deteriorated or destroyed, or for any reason whatsoever become unsuitable or unavailable for use in the Work, the full amount previously allowed shall be

**00 72 13**  
**General Conditions**

deducted from subsequent payments unless the Contractor satisfactorily replaces said material.

- 32.6 The Contractor may request certification of an appropriate dollar amount for materials not incorporated in the Work which have been delivered and suitably stored away from the site. The Contractor shall submit bills of sale, insurance certificates, right-of-entry documents or other such documents that will adequately protect the Owner's interests. The Consultant shall determine if the Contractor's documentation for the materials is complete and specifically designated for the Project. The Owner may allow certification of such payments.
- 32.7 Subcontractors may request, and shall receive from the Consultant, copies of approved Requisitions for Payment showing the amounts certified in the Schedule of Values.
- 32.8 Certified Requisitions for Payment, payments made to the Contractor, or partial or entire occupancy of the project by the Owner shall not constitute an acceptance of any work that does not conform to the Contract Documents. The making and acceptance of the final payment constitutes a waiver of all claims by the Owner, other than those arising from unsettled liens, from faulty work or materials appearing within one year from final payment or from requirements of the Drawings and Specifications, and of all claims by the Contractor, except those previously made and still unsettled.

**33. Payments Withheld**

- 33.1 The Owner shall retain five percent of each payment due the Contractor as part security for the fulfillment of the contract by the Contractor. The Owner may make payment of a portion of this "retainage" to the Contractor temporarily or permanently during the progress of the Work. The Owner may thereafter withhold further payments until the full amount of the five percent is reestablished. The Contractor may deposit with the Maine State Treasurer certain securities in place of retainage amounts due according to Maine Statute (5 M.R.S. §1746).
- 33.2 The Consultant may withhold or nullify the whole or a portion of any Requisitions for Payment submitted by the Contractor in the amount that may be necessary, in his reasonable opinion, to protect the Owner from loss due to any of the following:
- .1 defective work not remedied;
  - .2 claims filed or reasonable evidence indicating probable filing of claims;
  - .3 failure to make payments properly to Subcontractors or suppliers;
  - .4 a reasonable doubt that the contract can be completed for the balance then unpaid;
  - .5 liability for damage to another contractor.

The Owner shall make payment to the Contractor, in the amount withheld, when the above circumstances are removed.

**34. Liens**

- 34.1 The Contractor shall deliver to the Owner a complete release of all liens arising out of this contract before the final payment or any part of the retainage payment is released. The Contractor shall provide with the release of liens an affidavit asserting each release includes all labor and materials for which a lien could be filed. Alternately, the Contractor, in the event any Subcontractor or supplier refuses to furnish a release of lien

**00 72 13**  
**General Conditions**

- in full, may furnish a bond satisfactory to the Owner, to indemnify the Owner against any lien.
- 34.2 In the event any lien remains unsatisfied after all payments to the Contractor are made by the Owner, the Contractor shall refund to the Owner all money that the latter may be compelled to pay in discharging such lien, including all cost and reasonable attorney's fees.
35. Workmanship
- 35.1 The Contractor shall provide materials, equipment, and installed work equal to or better than the quality specified in the Contract Documents and approved in submittal and sample. The installation methods shall be of the highest standards, and the best obtainable from the respective trades. The Consultant's decision on the quality of work shall be final.
- 35.2 The Contractor shall know local labor conditions for skilled and unskilled labor in order to apply the labor appropriately to the Work. All labor shall be performed by individuals well skilled in their respective trades.
- 35.3 The Contractor shall perform all cutting, fitting, patching and placing of work in such a manner to allow subsequent work to fit properly, whether that be by the Contractor, the Owner's Contractors or others. The Owner and Consultant may advise the Contractor regarding such subsequent work. Notwithstanding the notification or knowledge of such subsequent work, the Contractor may be directed to comply with this standard of compatible construction by the Consultant at the Contractor's expense.
- 35.4 The Contractor shall request clarification or revision of any design work by the Consultant, prior to commencing that work, in a circumstance where the Contractor believes the work cannot feasibly be completed at the highest quality, or as indicated in the Contract Documents. The Consultant shall respond to such requests in a timely way, providing clarifying information, a feasible revision, or instruction allowing a reduced quality of work. The Contractor shall follow the direction of the Consultant regarding the required request for information.
- 35.5 The Contractor shall guarantee the Work against any defects in workmanship and materials for a period of one year commencing with the date of the Certificate of Substantial Completion, unless specified otherwise for specific elements of the project. The Work may also be subdivided in mutually agreed upon components, each defined by a separate Certificate of Substantial Completion.
36. Close-out of the Work
- 36.1 The Contractor shall remove from the premises all waste materials caused by the work. The Contractor shall make the spaces "broom clean" unless a more thorough cleaning is specified. The Contractor shall clean all windows and glass immediately prior to the final inspection, unless otherwise directed.
- 36.2 The Owner may conduct the cleaning of the premises where the Contractor, duly notified by the Consultant, fails to adequately complete the task. The expense of this cleaning may be deducted from the sum due to the Contractor.



**00 72 13**  
**General Conditions**

- 36.3 The Contractor shall participate in all final inspections and acknowledge the documentation of unsatisfactory work, customarily called the "punch list", to be corrected by the Contractor. The Consultant shall document the successful completion of the Work in a dated Certificate of Substantial Completion, to be signed by Owner, Consultant, and Contractor.
- 36.4 The Contractor shall not call for final inspection of any portion of the Work that is not completely and permanently installed. The Contractor may be found liable for the expenses of individuals called to final inspection meetings prematurely.
- 36.5 The Contractor and all major Subcontractors shall participate in the end-of-warranty-period conference, typically scheduled close to one year after the Substantial Completion date.
37. Date of Completion and Liquidated Damages
- 37.1 The Contractor may make a written request to the Owner for an extension or reduction of time, if necessary. The request shall include the reasons the Contractor believes justifies the proposed completion date. The Owner may grant the revision of the contract completion date if the Work was delayed due to conditions beyond the control and the responsibility of the Contractor. The Contractor shall not conduct unauthorized accelerated work or file delay claims to recover alleged damages for unauthorized early completion.
- 37.2 The Contractor shall vigorously pursue the completion of the Work and notify the Owner of any factors that have, may, or will affect the approved Schedule of the Work. The Contractor may be found responsible for expenses of the Owner or Consultant if the Contractor fails to make notification of project delays.
- 37.3 The Project is planned to be done in an orderly fashion which allows for an iterative submittal review process, construction administration including minor changes in the Work and some bad weather. The Contractor shall not file delay claims to recover alleged damages on work the Consultant determines has followed the expected rate of progress.
- 37.4 The Consultant shall prepare the Certificate of Substantial Completion which, when signed by the Owner and the Contractor, documents the date of Substantial Completion of the Work or a designated portion of the Work. The Owner shall not consider the issuance of a Certificate of Occupancy by an outside authority a prerequisite for Substantial Completion if the Certificate of Occupancy cannot be obtained due to factors beyond the Contractor's control.
- 37.5 Liquidated Damages may be deducted from the sum due to the Contractor for each calendar day that the Work remains uncompleted after the completion date specified in the Contract or an approved amended completion date. The dollar amount per day shall be calculated using the Schedule of Liquidated Damages table shown below.

**00 72 13**  
**General Conditions**

If the original contract amount is:	The per day Liquidated Damages shall be:
Less than \$100,000	\$250
\$100,000 to less than \$2,000,000	\$750
\$2,000,000 to less than \$10,000,000	\$1,500
\$10,000,000 and greater	\$1,500 plus \$250 for each \$2,000,000 over \$10,000,000

### 38. Dispute Resolution

#### 38.1 Mediation

- 38.1.1 A dispute between the parties which arises under this Contract which cannot be resolved through informal negotiation, shall be submitted to a neutral mediator jointly selected by the parties.
- 38.1.2 Either party may file suit before or during mediation if the party, in good faith, deems it to be necessary to avoid losing the right to sue due to a statute of limitations. If suit is filed before good faith mediation efforts are completed, the party filing suit shall agree to stay all proceedings in the lawsuit pending completion of the mediation process, provided such stay is without prejudice.
- 38.1.3 In any mediation between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

#### 38.2 Arbitration

- 38.2.1 If the dispute is not resolved through mediation, the dispute shall be settled by arbitration. The arbitration shall be conducted before a panel of three arbitrators. Each party shall select one arbitrator; the third arbitrator shall be appointed by the arbitrators selected by the parties. The arbitration shall be conducted in accordance with the Maine Uniform Arbitration Act (MUAA), except as otherwise provided in this section.
- 38.2.2 The decision of the arbitrators shall be final and binding upon all parties. The decision may be entered in court as provided in the MUAA.
- 38.2.3 The costs of the arbitration, including the arbitrators' fees shall be borne equally by the parties to the arbitration, unless the arbitrator orders otherwise.
- 38.2.4 In any arbitration between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

**Supplemental General Conditions**

Notice: The contract or delivery order to which this addendum is attached is made using federal assistance provided to the State of Maine by the US Department of Treasury under the American Rescue Plan Act ("ARPA"), Sections 602 and 603 of the Social Security Act, Pub. L. No. 117-2 (March 11, 2021).

**1. Equal Opportunity**

The Contractor shall comply with Executive Order 11246 of September 24, 1965 entitled "Equal Opportunity," as amended by Executive Order 11375 of October 13, 1967 and as supplemented by in Department of Labor Regulations (41 CFR Part 60). The equal opportunity clause for federally assisted construction contracts at 41 CFR Part 60-1.4 is incorporated by reference.

**2. Contract Work Hours and Safety Standards Act**

If the Contract is in excess of \$100,000 and involves the employment of mechanics or laborers, Contractor shall comply with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, Contractor shall be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than 1½ times the basic rate of pay for all hours worked in excess of 40 hours in the work week unless a higher rate is required by state or federal law. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

Contractor shall comply with the following required provisions:

- a. 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 unless a higher rate is required by state or federal law.
- b. Violation; liability for unpaid wages; liquidated damages: In the event of any violation of the clause set forth in paragraph (a) of this section the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a) of this section, in the sum of \$29 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) of this section.
- c. Withholding for unpaid wages and liquidated damages: The State of Maine shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b) of this section.

**Supplemental General Conditions**

- d. Subcontracts: The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a) through (d) 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) through (d) of this section.
- e. The Contractor or 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.
- f. Records to be maintained under this provision shall be made available by the Contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Department of Treasury, and the Department of Labor, and the Contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

**3. Environmental Compliance**

- a. Contracts and subgrants of amounts in excess of \$150,000 must comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401–7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251–1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).
- b. The Contractor shall comply with all applicable standards, orders, or requirements issued under section 508 of the Clean Water Act (33 U.S.C. 1368), Executive Order 11738, Environmental Protection Agency regulations (40 CFR Part 15), and section 308 of the Federal Water Pollution Control Act (33 U.S.C. 1318), that relate generally to inspection, monitoring, entry reports, and information, and with all regulations and guidelines issued thereunder.
- c. The Contractor shall comply with all applicable standards, orders, or requirements issued under the Resource Conservation and Recovery Act (RCRA); the Comprehensive Environmental Response Compensation and Liabilities Act (CERCLA); and any applicable Federal, Codes or Local environmental regulation.

**4. Protection for Whistleblowers**

- a. In accordance with 41 U.S.C. § 4712, Contractor may not discharge, demote, or otherwise discriminate against an employee in reprisal for disclosing to any of the list of persons or entities provided below, 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.
- b. The list of persons and entities referenced in the paragraph above includes the following:
  - i. A member of Congress or a representative of a committee of Congress;
  - ii. An Inspector General
  - iii. The Government Accountability Office;
  - iv. A Treasury employee responsible for contract or grant oversight or management;

**Supplemental General Conditions**

- v. An authorized official of the Department of Justice or other law enforcement agency;
  - vi. A court or grand jury; or
  - vii. A management official or other employee of Contractor, contractor, or subcontractor who has the responsibility to investigate, discover, or address misconduct.
- c. Contractor shall inform its employees in writing of the rights and remedies provided under this section, in the predominant native language of the workforce.

**5. Domestic Preference for Procurements**

Contractor should, to the greatest extent practicable under a Federal award, provide 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 (2 CFR 200.322).

**6. Procurement of recovered materials**

The Contractor shall comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds \$10,000 or the value of the quantity acquired during the preceding fiscal year exceeded \$10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines (2 CFR 200.323).

**7. Nondiscrimination**

The Contractor shall ensure that no person is denied benefits of, or otherwise be subjected to discrimination in connection with the Contractor's performance under this agreement, on the grounds of race, religion, color, national origin, sex, and handicap. Accordingly, and to the extent applicable, the Contractor covenants and agrees to comply with the following:

- a. 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.
- b. The Fair Housing Act, Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§ 3601, et seq.), which prohibits discrimination in housing on the basis of race, color, religion, national origin, sex, familial status, or disability
- c. Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. § 794)
- d. The Age Discrimination Act of 1975 (42 U.S.C. § 6101 et seq.) and regulations issued thereunder (45 CFR Part 90).
- e. Title II of the Americans with Disabilities Act of 1990, as amended (42 U.S.C. §§ 12101 et seq.), which prohibits discrimination on the basis of disability under programs, activities, and

**Supplemental General Conditions**

services provided or made available by state and local governments or instrumentalities or agencies thereto.

**8. Lobbying**

- a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.
- c. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.
- d. The Interim Final Rule, New Restrictions on Lobbying, issued by the Office of Management and Budget to implement the provisions of section 319 of Public Law 101-121 (31 U.S.C., Art 1352) is incorporated by reference.

**9. Drug-Free Workplace**

The Contractor will comply with the provisions of the Drug-Free Workplace Act of 1988 (Public Law 100-690, title V, subtitle D; 41 U.S.C. 701 et seq.) and maintain a drug-free workplace.

**10. Increasing Seat Belt Use in the United States**

Pursuant to Executive Order 13043, 62 FR 19217 (Apr. 18, 1997), Contractor is encouraged to adopt and enforce on-the-job seat belt policies and programs for its their employees when operating company owned, rented or personally owned vehicles.

**11. Reducing Text Messaging While Driving**

Pursuant to Executive Order 13513, 74 FR 51225 (October 6, 2009), Contractor is encouraged to adopt and enforce policies that ban text messaging while driving, and to establish workplace safety policies to decrease accidents caused by distracted drivers.

**12. Debarment and Suspension**

If the Contract is in excess of \$25,000, this Contract is a covered transaction for purposes of 2 C.F.R. Part 180 and 2 C.F.R. Part 3000. As such, the Contractor is required to verify that none of the Contractor's principals (defined at 2 C.F.R. § 180.995) or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935). The Contractor must comply with 2 C.F.R. Part 180, subpart C and 2 C.F.R. Part 3000, subpart C, and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into. This certification is a material representation of fact relied upon by The State of Maine. If it is later determined that the Contractor did not comply with 2 C.F.R. Part 180, subpart C and 2 C.F.R. Part 3000, subpart C, in addition to remedies available to The State of Maine, the federal government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to

**Supplemental General Conditions**

comply with the requirements of 2 C.F.R. Part 180, subpart C and 2 C.F.R. Part 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

**13. Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment**

Contractor shall use no funds provided under this Contract to:

- a. Procure or obtain;
- b. Extend or renew a contract to procure or obtain; or
- c. Enter into a contract (or extent or renew a contract) to procure or obtain equipment, services, or systems that uses 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).
  - i. For the purpose of public safety, security of government facilities, physical security surveillance of critical 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).
  - ii. Telecommunications or video surveillance services provided by such entities or using such equipment.
  - iii. 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.
- d. The Contractor shall insert the substance of this clause, including this paragraph, into all subcontracts and other contractual instruments (2 CFR 200.216).

**Data for Infrastructure Projects and Capital Expenditure Projects**

**14.1** Programmatic Data for Infrastructure Projects (Expenditure Category 5 (EC 5)): For all projects listed under the Water, Sewer<sup>1</sup>, and Broadband Expenditure Categories (see Appendix 1 of the Compliance and Reporting Guidance for a listing of expenditure categories), more detailed project-level information is required. The Contractor/ Sub-recipient acknowledges that they must provide the below-referenced data associated with the services tied to this service contract/sub-award. This information will be provided to the State of Maine Contracting Department (Owner/Department) by the Contractor/Sub-recipient. Contractors and Sub-recipients are only required to provide the specific information tied to the project associated with this contract/sub-award that fits into one or more listed ECs. Each project will be required to report expenditure data as described above, but will also report the following information:

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<sup>1</sup> Definitions for water and sewer Expenditure Categories can be found in the EPA's handbooks. For "clean water" expenditure category definitions, please see: <https://www.epa.gov/sites/production/files/2018-03/documents/cwdefinitions.pdf>. For "drinking water" expenditure category definitions, please see: <https://www.epa.gov/dwsrf/drinking-water-staterevolving-fund-national-information-management-system-reports>.

**Supplemental General Conditions**

1. All Water and Sewer projects (EC 5.1-5.18):
  - Projected/actual construction start date (month/year)
  - Projected/actual initiation of operations date (month/year)
  - Public Water System (PWS) ID Number
  - National Pollutant Discharge Elimination System (NPDES) Permit Number
  - Median Household Income of Service Area<sup>2</sup>
  - Lowest Quintile Income of the Service Area<sup>2</sup>
2. All Broadband Projects (EC 5.19-5.21):
  - Projected/actual construction start date (month/year)
  - Projected/actual initiation of operations date (month/year)
  - Location Details
  - Confirm that the project is designed to, upon completion, reliably meet or exceed symmetrical 100 Mbps download and upload speeds.
    - If the project is not designed to reliably meet or exceed symmetrical 100 Mbps download and upload speeds, explain why not, and
    - Confirm that the project is designed to, upon completion, meet or exceed 100 Mbps download speed and between at least 20 Mbps and 100 Mbps upload speed, and be scalable to a minimum of 100 Mbps download speed and 100 Mbps upload speed.
  - Confirm that the service provider for the project has, or will upon completion of the project, either participated in the Federal Communications Commission (FCC)'s Affordable Connectivity Program (ACP) or otherwise provided access to a broad-based affordability program that provides benefits to households commensurate with those provided under the ACP to low-income consumers in the proposed service area of the broadband infrastructure (applicable only to projects that provide service to households).
  - Detailed Project Information:
    - Project technology type(s) (Planned/Actual)
      - Fiber
      - Coaxial Cable
      - Terrestrial Fixed Wireless
      - Other (specify)
    - Total miles of fiber deployed (Planned/Actual)
    - Total number of funded locations served (Planned/Actual)
    - Pre-SLFRF Investment
      - Total Number of Funded Locations Served receiving 25/3 Mbps or below
      - Total Number of Funded Locations Served receiving between 25/3 Mbps and 100/20 Mbps
    - Post-SLFRF
      - Total Number Receiving Minimum 100/100 Mbps
      - Total Number Receiving Minimum 100/20Mbps and scalable to 100/100 Mbps
    - Total number of funded locations served, broken out by type (Planned/Actual):
      - Residential
        - Total Housing Units
      - Business
      - Community Anchor Institution
  - Location-by-Location Project Information

<sup>2</sup> \*For median income and lowest quintile income of Census Tracts and other geographic areas, Contractor/Sub-recipient should refer to the most recent American Community Survey 5-year estimates available through the Census website.



**Supplemental General Conditions**

For each location served by a Project, the Owner/Department must collect from the Contractor/Sub-recipient and submit the following information to Treasury using a predetermined file format that will be provided by Treasury (collection of certain fields will begin in October 2022, as specified below):

- Latitude/longitude at the structure where service will be installed (required starting October 2022) Technology used to offer service at the location (required starting October 2022)
- Location type (required starting October 2022)
  - Residential
    - If Residential, Number of Housing Units
  - Business
  - Community anchor institution
- Speed tier at the location post-SLFRF investment (collection to be phased in)
  - Maximum download speed offered
  - Maximum download speed delivered
  - Maximum upload speed offered
  - Maximum upload speed delivered
  - Latency
- Standardized FCC Identifiers
  - Fabric ID # (Broadband Serviceable Fabric Locations)
  - FCC Issued Provider ID #

### 3. Wage Rate Disclosures and Certifications for Capital Expenditure and Infrastructure Projects.

A. N/A

B. To the extent that the Contractor/Sub-recipient employs laborers and mechanics as defined by the Davis Bacon Act, the Contractor/Sub-recipient must provide a project employment and local impact report detailing:

- The number of employees of contractors and sub-contractors working on the project;
- The number of employees on the project hired directly;
- The number of employees on the project hired through a third party;
- The wages and benefits of workers on the project by classification; and
- Whether those wages are at rates less than those prevailing;
- Contractor/Sub-recipient must maintain sufficient records to substantiate this information upon request.

C. To the extent that the Contractor/Sub-recipient employs laborers and mechanics as defined by the Davis Bacon Act, the Contractor/Sub-recipient must provide a project workforce continuity plan, detailing:

**Supplemental General Conditions**

- How the Contractor/Sub-recipient will ensure the project has ready access to a sufficient supply of appropriately skilled and unskilled labor to ensure high-quality construction throughout the life of the project, including a description of any required professional certifications and/or in-house training;
- How the Contractor/Sub-recipient will minimize risks of labor disputes and disruptions that would jeopardize timeliness and cost-effectiveness of the project;
- How the Contractor/Sub-recipient will provide a safe and healthy workplace that avoids delays and costs associated with workplace illnesses, injuries, and fatalities, including descriptions of safety training, certification, and/or licensure requirements for all relevant workers (e.g., OSHA 10, OSHA 30);
- Whether workers on the project will receive wages and benefits that will secure an appropriately skilled workforce in the context of the local or regional labor market;
- Whether the project has completed a project labor agreement;
- Whether the project prioritizes local hires
- Whether the project has a Community Benefit Agreement, with a description of any such agreement.

**00 73 46**  
**Wage Determination Schedule**

**PART 1- GENERAL**

**1.1 Related Documents**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specifications Sections, apply to this Section.

**1.2 Summary**

- A. This Section includes the wage determination requirements for Contractors as issued by the State of Maine Department of Labor Bureau of Labor Standards or the United States Department of Labor.

**1.3 Requirements**

- A. Conform to the wage determination schedule for this project which is shown on the following page.

**PART 2 - PRODUCTS (not used)**

**PART 3 - EXECUTION (not used)**

# 00 73 46

## Wage Determination Schedule

**THIS DOCUMENT MUST BE CLEARLY POSTED AT ALL CONSTRUCTION SITES FUNDED IN PART WITH STATE FUNDS**

State of Maine Department of Labor - Bureau of Labor Standards  
Augusta, Maine 04333-0045 - Telephone (207) 623-7906

Wage Determination - In accordance with 26 MRS §1301 et. seq., this is a determination by the Bureau of Labor Standards, of the fair minimum wage rate to be paid to laborers and workers employed on the below titled project.

### 2024 Fair Minimum Wage Rates -- Heavy & Bridge Somerset County

Occupational Title	Minimum Wage	Minimum Benefits	Total
Brickmasons And Blockmasons	\$35.00	\$0.86	\$35.86
Buildozer Operator	\$36.84	\$29.53	\$66.35
Carpenter	\$30.65	\$4.81	\$35.46
Cement Masons And Concrete Finisher	\$22.67	\$2.21	\$24.88
Commercial Divers	\$30.00	\$24.74	\$54.74
Construction And Maintenance Painters	\$24.50	\$5.24	\$29.74
Construction Laborer	\$24.51	\$20.33	\$44.84
Crane And Tower Operators	\$33.29	\$8.19	\$41.48
Crushing Grinding And Polishing Machine Operators	\$23.00	\$4.94	\$27.94
Drywall And Ceiling Tile Installers	\$26.70	\$10.62	\$37.32
Earth Drillers - Except Oil And Gas	\$24.36	\$2.53	\$26.89
Electrical Power - Line Installer And Repairers	\$31.92	\$5.53	\$37.45
Electricians	\$35.35	\$8.47	\$43.82
Elevator Installers And Repairers	\$48.38	\$45.29	\$93.67
Excavating And Loading Machine And Dragline Operators	\$36.84	\$29.53	\$66.35
Excavator Operator	\$36.84	\$29.53	\$66.35
Fence Erectors	\$34.00	\$2.05	\$36.05
Flaggers	\$24.51	\$20.33	\$44.84
Floor Layers - Except Carpet/Wood/Hard Tiles	\$27.00	\$6.21	\$33.21
Glaziers	\$37.00	\$6.60	\$43.60
Grader/Scraper Operator	\$23.00	\$1.99	\$24.99
Hazardous Materials Removal Workers	\$21.50	\$1.54	\$23.04
Heating And Air Conditioning And Refrigeration Mechanics And Installers	\$32.00	\$5.46	\$37.46
Heavy And Tractor - Trailer Truck Drivers	\$23.10	\$2.50	\$25.60
Highway Maintenance Workers	\$20.00	\$0.00	\$20.00
Industrial Machinery Mechanics	\$32.00	\$0.96	\$32.96
Industrial Truck And Tractor Operators	\$30.00	\$2.90	\$32.90
Insulation Worker - Mechanical	\$24.05	\$3.59	\$27.64
Ironworker - Ornamental	\$27.75	\$4.50	\$32.25
Light Truck Or Delivery Services Drivers	\$22.84	\$1.25	\$24.09
Millwrights	\$35.25	\$9.15	\$44.40
Mobile Heavy Equipment Mechanics - Except Engines	\$30.25	\$7.53	\$37.78
Operating Engineers And Other Equipment Operators	\$28.00	\$2.67	\$30.67
Paver Operator	\$25.30	\$3.73	\$29.03
Pile-Driver Operators	\$32.75	\$1.95	\$34.70
Pipelayers	\$28.50	\$4.89	\$33.39
Plumbers Pipe Fitters And Steamfitters	\$36.00	\$20.11	\$56.11
Pump Operators - Except Wellhead Pumps	\$31.49	\$32.08	\$63.57
Radio Cellular And Tower Equipment Installers	\$27.00	\$3.90	\$30.90
Reclaimer Operator	\$27.03	\$7.68	\$34.71
Reinforcing Iron And Rebar Workers	\$22.67	\$25.11	\$47.78
Riggers	\$31.25	\$7.68	\$38.93
Roofters	\$24.00	\$3.35	\$27.35
Screen/Wheelman	\$29.25	\$4.94	\$34.19
Sheet Metal Workers	\$28.13	\$6.76	\$34.89
Structural Iron And Steel Workers	\$30.38	\$7.49	\$37.87
Tapers	\$28.00	\$1.71	\$29.71
Telecommunications Equipment Installers And Repairers - Except Line Installers	\$28.33	\$6.08	\$34.41
Telecommunications Line Installers And Repairers	\$24.50	\$5.71	\$30.21
Tile And Marble Setters	\$27.75	\$6.73	\$34.48

Welders are classified as the trade to which welding is incidental (e.g. welding structural steel is Structural Iron and Steel Worker)

Apprentices - The minimum wage rates for registered apprentices are the rates recognized in the sponsorship agreement for registered apprentices working in the pertinent classification.

For any other specific trade on this project not listed above, contact the Bureau of Labor Standards for further clarification.

Title 26 §1310 requires that a clearly legible statement of all fair minimum wage and benefits rates to be paid the several classes of laborers, workers and mechanics employed on the construction on the public work must be kept posted in a prominent and easily accessible place at the site by each contractor and subcontractor subject to sections 1304 to 1313.

Appeal - Any person affected by the determination of these rates may appeal to the Commissioner of Labor by filing a written notice with the Commissioner stating the specific grounds of the objection within ten (10) days from the filing of these rates.

A true copy

Attest:

Scott R. Cotnoir  
Wage & Hour Director  
Bureau of Labor Standards

Expiration Date: 12-31-2024  
Revision Date: 1-3-2024

End of Section 00 73 46



# DIVISION 01

## GENERAL REQUIREMENTS



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**SECTION 01 11 00**  
**SUMMARY OF WORK**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. General:
  - 1. Furnish all labor, materials, tools, equipment and services as indicated in accordance with provisions of Contract Documents.
  - 2. It is the intent of the Contract Documents to describe a functionally complete project. Furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and functional installation.

**1.2 LOCATION**

- A. Embden State Fish Hatchery  
Maine Department of Inland Fisheries and Wildlife  
809 Cross Town Rd.  
Embden, Maine 04958
- B. Contractor should verify site access and haul routes for materials and concrete delivery prior to bidding.
- C. To make arrangements to visit the site, please contact the hatchery manager, Mr. Richard Parker, 207.287.5218.

**1.3 DEFINITIONS**

- A. USER: Maine Department of Inland Fisheries and Wildlife (MDIFW). MDIFW is the Using Agency for the Embden State Fish Hatchery.

**1.4 WORK COVERED BY CONTRACT**

- A. The Work of this Contract under the Base Bid generally includes the following:
  - 1. Construction of circular settling clarifier
  - 2. Construction of sludge storage facility
  - 3. Construction of chemical dosing building
- B. General: Renovation of a portion of an existing facility.
  - 1. Furnish all labor, materials, tools, equipment and services as indicated in accord with provisions of Contract Documents.
  - 2. It is the intent of the Contract Documents to describe a functionally complete project. Furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and functional installation.

**1.5 WORK BY OTHERS**

- A. Coordinate the construction with the utilities and Contractor shall provide adequate notice to the utilities of any work required in advance or requiring presence of their personnel. Contacts for coordination with the utilities are as follows:

Central Maine Power  
Dan Begin  
Phone: 207.629.4517 (Eng)

## **1.6 WORK SEQUENCE**

- A. The Contractor shall organize and plan the construction activities to minimize disruption to ongoing fish hatchery operations.
- B. Organize and plan the construction activities to assure the safety and reliability of and to minimize the interruption to the electric system and all other utilities.
- C. The proposed Work sequence shall be submitted to the USER in the Schedule of Construction.

## **1.7 USER OCCUPANCY**

- A. USER will occupy the premises during the entire period of construction for the conduct of his normal operations. Coordinate with USER in all construction operations to minimize conflicts and to facilitate USER usage.

## **1.8 OUTAGES**

- A. Organize and plan the construction activities so that the number and length of any required outages shall be minimized.
- B. An outage to any customer shall require specific approval of the USER. The USER reserves the right to reject any request for an outage.
- C. In some cases it may be necessary, at Contractor's expense, to either install temporary facilities for service or schedule the Work during a period when the outage would have minimal impact on the customer.
- D. Provide the USER at least 48 HRS notice in advance of any requested outage so that the USER may advise and coordinate the outage with the customers.

## **1.9 USER-FURNISHED PRODUCTS**

- A. Products furnished and paid for by USER shall be as follows: None.

## **1.10 CONTRACTOR-FURNISHED PRODUCTS**

- A. Furnish all products, other than USER-furnished products designated above.
- B. Components required to be supplied in quantity within a specification section shall all be the same and shall be interchangeable.
- C. Unless otherwise indicated in the Contract Documents, provide materials and equipment that:
  - 1. is produced by reputable manufacturers having adequate experience in the manufacture of these items; and
  - 2. is designed for the service intended; and
  - 3. have not been previously been incorporated into another project or facility; and
  - 4. have not changed ownership since their initial production or fabrication and shipment from the manufacturer's factory or facility; and
  - 5. if stored since their manufacture or fabrication, have, while in storage, been properly maintained and serviced in accordance with the manufacturer's recommendations for long-term storage; submit documentation under the relevant technical section that such maintenance and service has been performed; and
  - 6. have not been subject to degradation or deterioration since manufacture; and
  - 7. are the current model(s) or type(s) furnished by the Supplier and only modified as necessary to comply with the design.

## **1.11 UNDERGROUND UTILITIES**

- A. Utilities may have underground facilities in the vicinity of the Work, contact as follows:



Central Maine Power  
Dan Begin  
Phone: 207.629.4517 (Eng)

#### **1.12 PERMITS AND LICENSES**

- A. USER has applied for and obtained, at USER's expense, the following permits and approvals for the Work (Note: both submittals currently undergoing review):
  - 1. Environmental Impact Report (EIR) to Maine Department of Environmental Quality (MDEQ)
  - 2. Joint Permit Application to USACE (U.S. Army Corps of Engineers).
- B. Obtain, at contractor expense, all other permits and licenses necessary for the construction of the Work.

#### **1.13 TREE TRIMMING, CLEARING, AND TREE REMOVAL**

- A. Provide all required labor and equipment for trimming, clearing, and tree removal. See Section 31 10 00.

#### **1.14 FENCES**

- A. All fences affected by the Work shall be maintained by the Contractor until completion of the Work. Fences disturbed by the construction shall be restored by the Contractor to their original or better condition and to their original location unless otherwise indicated.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

#### **END OF SECTION**

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**SECTION 01 26 13**  
**REQUESTS FOR INFORMATION (RFI)**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section defines the process for handling Requests for Information (RFI).
- B. Questions during the bid process will need to be submitted in writing as outlined in the Instructions to Bidders.
- C. AFTER the bid award, RFIs are intended to provide clarifications and interpretations of the Contract Documents and maintain progress of Work.
- D. RFIs are not intended for general communication, requesting substitutions, requesting proposed changes, resolution of nonconforming work, or coordination between contractors.

**1.2 RFI SUBMITTAL PROCEDURE**

- A. All RFIs shall be submitted via Newforma Project Management Environment, or on mutually agreeable forms.
- B. When needed, the RFI shall include backup information to clarify the request.
  - 1. Backup information can include verified field measurements, quantities, dimensions, photos showing existing conditions, and any other information that will assist the Engineer in reviewing and responding to the RFI.
- C. Within fifteen (15) working days of receipt of RFI, Engineer will return a response to the RFI, request additional information, or will provide a schedule of when a response will be issued.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION**

**3.1 REQUESTS FOR INFORMATION**

- A. Review of Contract Documents and Field Conditions:
  - 1. Before starting each portion of Work, carefully study and compare drawings, specifications and other contract documents, coordination drawings, shop drawings, prior correspondence or documentation relative to that portion of Work, and any other information furnished by Engineer.
  - 2. Evaluate field conditions and take field measurements related to that portion of Work.
  - 3. Any inconsistencies discovered in the above review of the contract documents and field conditions should be submitted to the Engineer in an RFI.
- B. Contractor's Responsibilities:
  - 1. When interpretation, clarification or explanation of portion of Construction Documents is needed by Contractor or its Subcontractor, Vendor or Supplier, the request shall be processed through the Contractor.
    - a. Review the RFI for completeness, quality, proper referencing drawings, specification or other contract documents.
    - b. When submitting RFI's generated from subcontractors, suppliers, and others, make every attempt to validate, resolve or respond to RFI by thoroughly researching and reviewing Contract Documents and field conditions before transmitting to the Engineer.
    - c. If the RFI is not clear, concise, complete and easily understood, do not submit the RFI to Engineer for response.

2. Follow these procedures in developing an RFI:
    - a. List relevant Contract Documents when seeking information being requested.
      - 1) Reference all applicable Contract Drawings by sheet number.
      - 2) Specifications by section and paragraph number
      - 3) Reference any other relevant documents.
    - b. Clearly state any additional information needed so request can be fully understood, including sketches, photos or other reference material.
    - c. Suggest any reasonable solutions and recommendations which will aid in determining a solution or response.
    - d. Any critical RFI's requiring a rapid response shall clearly indicate such with an explanation as to why RFI is critical.
    - e. Priority for responses shall be indicated when multiple RFI's are submitted within short period of time.
  3. A response to RFI shall not be considered a notice to proceed with a change that may revise the Contract Sum or Contract Time, unless authorized by the Engineer in writing.
  4. If response to RFI is determined incomplete, it shall be resubmitted with reason response is unacceptable and any necessary additional information within five (5) days of time of receipt of response to RFI.
- C. RFI Submittal Numbering:
1. RFI's shall be assigned unique numbers in sequential order (1, 2, 3, 4, etc.).
  2. A resubmitted RFI or a previously answered RFI requiring revising or further clarification shall be submitted using original RFI number proceeded by ".1 IN to indicate revision one of RFI (i.e.: RFI No. 34.1 for revision 1 to RFI No. 34).
- D. Invalid RFI
1. Engineer may return RFI without response for following reasons:
    - a. Request is unclear or incomplete.
    - b. Request was answered in a previous RFI.
    - c. Requested information is readily available in the Construction Documents.
    - d. Request is related to construction means, methods or techniques.
    - e. Request is related to health or safety measures.
    - f. Request is due to Contractor's lack of adequate coordination.
    - g. Issue relates to coordination between Subcontractors.
    - h. Request is a "Substitution Request."
    - i. Request is a "Contractor Proposed Change."
    - j. Request is due to non-conformance.

## END OF SECTION



EXHIBIT A

# Request for Information Form

Contractor's RFI No. \_\_\_\_\_

Engineer's RFI No. \_\_\_\_\_

Contract: \_\_\_\_\_

Contractor: \_\_\_\_\_

Owner: \_\_\_\_\_

Owner's Contract No. \_\_\_\_\_

Engineer **HDR Engineering, Inc.**

THIS REQUEST BY: \_\_\_\_\_ cc to: \_\_\_\_\_  
(Name of the Contractor's Representative)

REFERENCE: DIVISION \_\_\_\_\_ SECTION \_\_\_\_\_ PLAN SHEET NO. \_\_\_\_\_

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ATTACHMENTS \_\_\_\_\_

INTERPRETATION BY: \_\_\_\_\_ Date: \_\_\_\_\_, 20\_\_\_\_  
(Name of the Engineer)

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ATTACHMENTS \_\_\_\_\_

The General Conditions (GCs) specify that once the Engineer provides a response to a Contractor's RFI, that determination shall be final and binding on the Contractor unless the Contractor delivers to the Owner written notice of a change in the work within a certain period of time of receipt of that determination. See the GCs for further clarification.

cc to: \_\_\_\_\_  
\_\_\_\_\_

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**SECTION 01 29 73**  
**SCHEDULE OF VALUES (LUMP SUM PROJECTS)**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Administrative and procedural requirements for:
    - a. Schedule of Values.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Building Code:
    - a. Maine Uniform Statewide Building Code (USBC, 2015)

**1.3 SUBMITTALS**

- A. Within 10 days after the Effective Date of the Contract, Contractor shall submit a Preliminary Schedule of Values for all the Work to the Owner for timely review.

**1.4 SCHEDULE OF VALUES**

- A. Where a Contract is awarded on a lump sum basis, file with the Owner a balanced price segregation of the lump sum bid into items similar to the various subdivisions of the general and detailed specifications, the sum of which shall equal the lump sum bid.
  - 1. The cost of various materials shall be furnished upon request of the Owner, and such data will then be used as a basis for making progress estimates.
  - 2. Breakdown costs, itemized by Specification Section and trade, and distribute cost to individual applicable units and structures.
  - 3. Where structures, units, equipment or other components are identified by a specific series or, identification number, utilize said designation throughout cost breakdown.
  - 4. Provide detailed breakdown for individual yard piping or conduit runs and identify approximate quantities involved to satisfaction of the Owner.
  - 5. Provide separate breakdown for change order items requested.
- B. A reasonable allocation of the Contract Price to the component parts of the Work will be approved if component parts of the Work have values assigned to them that are well-balanced with respect to relative values for similar work established by published estimating guides.
  - 1. Unless otherwise agreed to at the Preconstruction Conference, Means Estimator Guide or other similar nationally recognized estimating guide shall be used for resolving differences between Owner's and Contractor's opinions of allocation of values.
- C. Contractor's costs shall not govern the allocation of values when application of Contractor's costs to a component part of the Work results in any other component part or combination of component parts being under-valued in relation to conventional estimating guides.
- D. SCHEDULE OF VALUES shall be agreed upon prior to first Application for Payment.

**1.5 APPLICATION FOR PAYMENT**

- A. Provide a Summary Sheet and cost breakdown as required by Owners's Sourcing Division.
- B. Provide an additional breakdown sheet, showing the tabulation format for stored materials.
- C. Submit these sheets each month with Contractor's pay request breakdown.

- D. The detail and format of cost breakdown and stored materials tabulation sheet shall be fully approved by Owner.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**END OF SECTION**



**SECTION 01 30 00**  
**SPECIAL CONDITIONS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Administrative and procedural requirements for:
    - a. Project signs.
    - b. Temporary sanitary facilities
    - c. Temporary utilities
    - d. Temporary Heating, Ventilating and Cooling
    - e. Temporary Electricity and Lighting
    - f. Temporary Water
    - g. Contractor's Superintendent's Field Office.
    - h. Drawings and Contract Documents for Contractor use.
    - i. Project photographs.
    - j. Special considerations related to adjacent properties and facilities.
    - k. Historical and archaeological finds.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Building code:
    - a. Maine Uniform Statewide Building Code (USBC, 2015)

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Project Sign Layout and mounting design.

**1.4 PROJECT SIGNS**

- A. Within 10 days after receipt of Notice to Proceed, furnish, install, and maintain a Project Sign as defined herein. No other signs will be allowed on the project unless approved in writing by the Owner.
- B. Project Sign Materials:
  - 1. The Project Sign will be produced by an experienced professional sign company.
  - 2. The Project Sign shall be structurally adequate and suitable for exterior application. Project Sign panels shall be constructed using a 4 FT and 8 FT, 3/4 IN new A-B Grade, exterior type, APA MDO plywood both sides.
  - 3. The Project Sign paint shall be exterior quality, as specified in Division 09 or as a minimum, primer and finish coat: exterior, semi-gloss, enamel. Colors for the sign and structure, framing, sign surfaces, and graphics shall be as shown on the Drawings or as selected by the Owner.
  - 4. Prior to producing the sign, submit a layout of the sign to the Owner for review and approval. The layout shall include content, lettering style and color and background colors.
- C. Information to be included on the Project Sign will include:
  - 1. Project Name.
  - 2. Owner's Name.

3. Engineer.
  4. Contractor.
  5. Construction Manager.
  6. Funding Agencies (if required by the funding agreement).
  7. Construction dollar amount (if required by the funding agency and/or client).
  8. Company and Agency Logos (if approved by the Owner).
- D. Installation of the Project Sign:
1. The Project Sign shall be constructed with new materials and kept clean throughout the project duration.
    - a. Install Project Sign as shown in the Drawings.
  2. The Project Sign shall be mounted to resist wind loads as required by authorities having jurisdiction but not less than wind velocity of 50 MPH.
  3. Prior to installing the sign, submit mounting design to the Owner for review and approval.
  4. The Project Sign shall be erected level and plumb.
- E. Remove signs, framing, supports, and foundations to a depth of at least 2 FT upon completion of Project. Restore area to a condition equal to or better than before construction.

## **1.5 TEMPORARY SANITARY FACILITIES**

- A. Provide temporary sanitary facilities for use of construction workers during construction, remodeling or demolition activities.
- B. Do not use existing toilet facilities in occupied areas or new toilet facilities in construction area without Owner's written consent.
- C. Provide facilities complying with local, State and Federal sanitary laws and regulations.
- D. Follow facility provider's minimum maintenance frequency or service more frequently to keep in clean and sanitary condition.
- E. Provide adequate supplies of toilet paper, cleaning supplies, and other required items.

## **1.6 TEMPORARY UTILITIES**

- A. Provide fees, labor, and materials, including temporary equipment and connection thereof, required to provide temporary utility services necessary for maintaining existing services and for execution of Work, and tests required in various sections of Specifications at Contractor's expense, except where otherwise specified.
- B. Maintain temporary services and facilities clean and neat in appearance, including those furnished or provided by Owner for Contractor's use.
- C. Coordinate with Owner to relocate temporary services and facilities as Work progresses.
- D. Do not overload facilities or permit them to interfere with progress.
- E. Take necessary fire prevention measures.
- F. Preclude hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on site.
- G. Prepare schedule indicating dates for implementation, shut downs, tie-ins and termination of each temporary utility and coordinate with Owner.
- H. At earliest possible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
- I. Remove temporary equipment and connections, and leave premises and existing permanent apparatus in an equivalent condition as existed prior to making temporary connections.
  1. Service utility connections shall be discontinued and capped in accordance with the approved rules and the requirements of the authority having jurisdiction.
  2. At completion of Work, remove and replace damaged parts of permanent systems.

- J. Extend warranty or guarantee period on permanent systems used during construction period so they commence on date of Substantial Completion.

## **1.7 TEMPORARY HEATING, VENTILATION, AND COOLING**

- A. Maintain temperature of spaces where concrete is being placed or cured: See Section 03 31 31.
- B. Provide temporary heating, ventilation, and cooling equipment; and provide temporary heating ventilation, and cooling as required to perform Work.
  - 1. Substantially complete exterior envelope prior to start of energy systems.
  - 2. Make temporary electrical connections and disconnect temporary connections at completion of temporary heating, ventilation and cooling period.
  - 3. Operate system, furnishing necessary labor and supervision.
  - 4. Maintain interior temperature and humidity at service temperature and service humidity for at least 48 HRS prior to, concrete slab moisture emission and relative humidity testing, and continue through placement of interior finishes, and until Substantial Completion.
    - a. Provide temperature and humidity range required by interior-finish manufacturer's instructions.
- C. Select equipment that is harmless on occupants, elements being installed and completed installations.
- D. Coordinate requirements to produce condition required and minimize consumption of energy.
- E. Provide adequate forced ventilation of enclosed areas for welding, painting, curing of installed materials and fume producing equipment, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
- F. Contractor pay energy costs until Substantial Completion.
- G. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is acceptable for operation, equipment is lubricated and filters are in place.
- H. Provide and pay for operation, maintenance and regular replacement of filters, and worn or consumed parts.
- I. Use devices complying with codes and ordinances.

## **1.8 TEMPORARY ELECTRICITY AND LIGHTING**

- A. Provide equipment, poles, meter, wiring, switches, outlets, to provide 480V, 3 phase power and necessary step down transformers for 208V and 120V power for construction lighting and power requirements.
  - 1. Permanent building power distribution system may be used.
  - 2. Remove temporary electrical equipment when no longer needed.
- B. Provide adequate lighting with local switching for safe access and egress, security, and for providing adequate illumination for construction operations.
  - 1. Turn off lighting in areas at end of work day to conserve energy.
  - 2. Re-lamp permanent light fixtures used during construction with new lamps at Substantial Completion.
- C. Temporary electrical power used will be paid for by Contractor until Substantial Completion.
- D. Provide own extension cords and electrical safety devices.
- E. Provide any additional electrical power required for installer's operation, exceeding available power.

## **1.9 TEMPORARY WATER**

- A. Make arrangements; provide equipment, piping, and outlets for an adequate supply of clean water for construction purposes.
  - 1. Existing water distribution system may be used for temporary service.
  - 2. Provide temporary meters and pay costs of installation and use.
  - 3. Provide pressure backflow preventer at each connection.
  - 4. Disinfect temporary piping before use.
- B. Contractor is responsible to pay for water used until Substantial Completion.
- C. Furnish drinking water for those connected with the Work.

## **1.10 CONTRACTOR'S SUPERINTENDENT'S FIELD OFFICE**

- A. Establish at site of Project.
- B. Equipment: Telephone, telecopy, mailing address, and sanitary facilities.
- C. Ensure attendance at this office during the normal working day.
- D. At this office, maintain complete field file of Shop Drawings, posted Contract Drawings and Specifications, and other files of field operations including provisions for maintaining "As Recorded Drawings."
- E. Remove field office from site upon acceptance of the entire work by the Owner.
- F. Safety Equipment:
  - 1. One 10 LB ABC dry powder fire extinguisher, upright and fully charged, in an easily accessible location.
  - 2. One OSHA, "Employee Right to Know" Poster, prominently displayed.
  - 3. One first aid kit.
  - 4. One weather radio.

## **1.11 OWNER DRAWINGS AND CONTRACT DOCUMENTS FOR CONTRACTOR USE**

- A. Owner shall furnish to Contractor two printed copies of the Contract Drawings and Specifications and one copy of each in electronic format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Pick up all "no-charge" documents within 10 days from date of Notice to Proceed.
- C. Additional documents after "no-charge" documents will be furnished to Contractor at cost.

## **1.12 PROJECT PHOTOGRAPHS**

- A. At least every two weeks during construction of the Work, provide progress pictures as directed by Owner.
  - 1. Pictures shall be digital and provided electronically.
  - 2. Provide number of photographs as follows:
    - a. 24 ground level color photos per month.
    - b. Three color overview photos taken at each of the following:
      - 1) At 0 PCT complete.
      - 2) At three month intervals after initial set.
      - 3) At 100 PCT complete.
  - 3. Schedule and coordinate photographer with Owner.
  - 4. Date all photographs.

## **1.13 SPECIAL CONSIDERATIONS RELATED TO ADJACENT PROPERTIES AND FACILITIES**

- A. Contractor shall be responsible for negotiations of any waivers or alternate arrangements required to enable transportation of materials to the site.

- B. Access, Traffic Control, and Parking:
1. Maintain conditions of access road to site such that access is not hindered as the result of construction related deterioration.
  2. Do not permit driving across or transporting materials or equipment across areas outside the construction limits shown on the Drawings.
  3. Provide traffic control devices and personnel necessary to ensure a safe interface of construction traffic with business traffic to and from adjacent sites.
  4. Provide access routes for emergency vehicles at all times.
  5. Provide daily sweeping of hard-surface roadways to remove soils tracked onto roadway.
  6. Provide on-site parking for all staff to limit interference with adjacent properties and businesses.

#### **1.14 HISTORICAL AND ARCHAEOLOGICAL**

- A. If during the course of construction, evidence of deposits of historical or archeological interest is found, cease operations affecting the find and shall notify Owner.
1. No further disturbance of the deposits shall ensue until the Contractor has been notified by Owner that Contractor may proceed.
  2. Owner will issue a notice to proceed after appropriate authorities have surveyed the find and made a determination to Owner.
  3. Compensation to the Contractor, if any, for lost time or changes in construction resulting from the find, shall be determined in accordance with changed or extra work provisions of the Contract Documents.
  4. The site has been previously investigated and has no known history of historical or archaeological finds.

#### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

#### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

#### **END OF SECTION**

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## **SECTION 01 32 17**

### **CONSTRUCTION PROGRESS SCHEDULE**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Specific requirements for the preparation, submittal, updating, and status reporting of the construction Progress Schedule.
- B. Related Specification Sections include, but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
- C. Review of the CPM Schedule:
  - 1. In so far as the Contractor is solely responsible for its means and methods and the CPM schedule represents in part its means and methods, the review of the CPM schedules (preliminary, baseline, updates, revisions, etc.) is for compliance with the requirements as defined in the contract documents.
  - 2. The review of the CPM schedule is not intended to be complete or exhaustive or check every activity and its relation to the work.
  - 3. The Engineer will provide comments on the CPM schedule compliance with contract requirements and anomalies.
  - 4. If the Contractor fails to include contract requirements (e.g. specified cure times, commissioning periods) in the CPM schedule, or the Engineer fails to notify the Contractor of anomalies, the Contractor is not relieved of the contract requirements.
  - 5. Acceptance of the CPM schedule does not imply that the Engineer has approved or accepted the Contractor's means and methods or sequence for performing the work to construct the project.
  - 6. If the Contractor has questions or concerns about comments, the Contractor and Engineer will meet to resolve those issues prior to issuance of future updates or revisions.

##### **1.2 DEFINITIONS**

- A. The following definitions shall apply to this Specification Section:
  - 1. **EXECUTION OF THE CONTRACT:** The date the contract is signed by the last party, either Engineer or the Contractor.
  - 2. **WORKING DAYS:** Monday through Friday except holidays as directed by the Engineer.
  - 3. **BASELINE SCHEDULE:** The initial detailed Progress Schedule prepared by the Contractor defining its plan for constructing the Project in accordance with the Contract Documents.
  - 4. **SCHEDULE UPDATE:** The initially accepted Baseline Schedule, or subsequently approved Revised Baseline Schedules, updated each month to reflect actual start and finish dates of each schedule activity and the remaining duration of activities that began during the period.
  - 5. **CURRENT SCHEDULE:** The current schedule is either the Baseline Schedule or Revised Baseline Schedule including and incorporating Schedule Updates.
  - 6. **REVISED BASELINE SCHEDULE:** The initially accepted Baseline Schedule revised to reflect approved contract change orders and modifications.
  - 7. **RECOVERY SCHEDULE:**
    - a. A schedule indicating the Contractor's plan for recovering lost time.
    - b. A recovery schedule will be requested when the Contractor is forecasting at least 10 working days or more delays in meeting a contract milestone or the contract completion date.
  - 8. **SHORT INTERVAL SCHEDULE:**
    - a. Schedule prepared by the Contractor reflecting the work planned for the coming weeks.

- b. This is also known as a Look-Ahead Schedule.

### 1.3 SUBMITTALS

#### A. Baseline Schedule:

1. Submittal and review:
  - a. Submit within 30 days after Execution of the Contract or the effective date of the contract, whichever is earlier.
  - b. The Engineer shall review the baseline schedule and provide comments to the Contractor within twenty (20) working days after receipt of the schedule.
  - c. After receiving comments, the Contractor and Engineer shall meet to review the comments within five (5) working days.
  - d. After the meeting, the Contractor will modify the schedule as agreed and resubmit the baseline schedule within 5 working days.
  - e. After the Engineer confirms that the Contractor has made the changes as agreed, the schedule will become the baseline schedule.
2. Submittal package:
  - a. CPM time-scaled network diagram:
    - 1) A printed logic diagram and PDF that include the following information:
      - a) Unique activity number/identifier; numeric, alpha or combination of numeric/alpha.
      - b) Activity description.
      - c) Activity duration.
      - d) Early start and early finish for each activity.
      - e) Late start and late finish for each activity.
      - f) Total float (TF) for each activity.
      - g) Predecessor activities.
      - h) Successor activities.
      - i) Cost/budget to complete the work in the activity.
      - j) Resources needed to complete the activity.
      - k) Bar showing the early start and completion dates of each activity.
    - 2) The activities will be sorted by area, trades, and subcontractors as agreed on with the Engineer.
    - 3) Print the CPM time-scaled network diagram on minimum sheet size of 11 IN x 17 IN.

#### B. Schedule Updates:

1. Submittal and Review:
  - a. Provide a Schedule Update on the 4th of each month after the Baseline Schedule is completed.
  - b. The Engineer shall provide comments to the Contractor on the Schedule Update.
  - c. Incorporate the Engineer's comments into the next Schedule Update.
2. CPM time-scaled network diagram as described for the Baseline Schedule:
  - a. Do not change the description of an activity number.
    - 1) Any activity added to the schedule shall have a new unique activity number and description.
    - 2) If activities are deleted, the deleted activity number(s) will not be used again.

#### C. Recovery Schedule:

1. When the activities on the critical path or the completion milestones appear to be fifteen (15) working days beyond the contract time, the Engineer may request and provide a Recovery Schedule demonstrating how the Contractor will recover the lost time so that the Work will be completed within the Contract Time.
2. Provide the Recovery schedule within ten (10) working days after requested by the Engineer.
3. Activities will be added or the durations modified to reflect the changes to the work.



4. The Engineer will review and provide comments to the Contractor on the Recovery Schedule within five (5) working days.
  5. Incorporate the Engineer's comments into the Recovery Schedule.
  6. After acceptance by the Engineer, the Recovery Schedule use for future Schedule Updates.
  7. CPM time-scaled network diagram as described for the Baseline Schedule:
    - a. Do not change the description of an activity number.
      - 1) Any activity added to the schedule shall have a new activity number and description.
      - 2) If activities are deleted, the deleted activity number(s) will not be used again.
  8. Provide a narrative with an explanation of the changes in logic and/or activity durations.
- D. Short Interval Schedule:
1. Provide a four-week schedule each week during the Contract Time. This schedule can be reviewed at each progress meeting.
    - a. Provide an accurate representation of the work performed the previous week and work planned for the current week and subsequent two (2) weeks.
  2. Provide in a tabular format with bars or other graphic representing work duration.
    - a. Reference activity ID numbers on the Baseline, Revised Baseline, or Updated Schedule, which ever is being currently used.
    - b. Note by color, highlight or underscore all activities on the critical path.
  3. Identify inspection hold points including special inspections needed before the Contractor can move forward with the work.
  4. Identify the day materials provided by Engineer or others are needed on site.
  5. Identify utility tie-ins and traffic changes including road and/or lane closures.

#### **1.4 GENERAL REQUIREMENTS**

- A. Prepare and submit construction progress schedules as specified herein.
1. Develop and maintain Baseline, Updates and Recovery schedules using Microsoft Project or equal as approved by the Engineer.
  2. Include the following information:
    - a. Construction start dates (Award date, Notice(s) to Proceed date).
    - b. Procurement activities.
    - c. Preparation of key submittals for materials and equipment.
    - d. Engineer's review and approval of key submittals.
    - e. Material and equipment fabrication lead times.
    - f. Material and equipment deliveries for Contractor, Engineer and third parties.
    - g. Water curing of concrete after placement for all structures.
    - h. Shutdowns.
    - i. Utility tie-ins.
    - j. Plant tie-ins.
    - k. Traffic changes and closures.
    - l. Inspections and hold points.
    - m. Start up of equipment.
    - n. Testing of equipment and systems.
    - o. Training
    - p. Commissioning.
    - q. Contract milestones:
      - 1) Intermediate milestones.
      - 2) Substantial Completion Date.
      - 3) Physical Completion Date.
  3. The following CPM schedule outputs will be rejected without further review:
    - a. Schedules indicating the start of the critical path at a date point or activity beyond the date of Notice to Proceed, or schedules indicating a discontinuous critical path from Notice to Proceed to Contract completion.

- b. Schedules defining critical activities as those on a path or paths having some minimum value of float.
  - c. Schedules with multiple critical paths.
  - d. Schedules indicating a completion date beyond the contractual completion date.
- B. The number of activities shall be sufficient to assure adequate planning of the project, to permit monitoring and evaluation of progress, and to do an analysis of time impacts.
  - 1. Schedule activities shall include the following:
    - a. A clear and legible description.
    - b. At least one (1) predecessor and one (1) successor activity, except for project start and finish milestones.
- C. Early Completion Schedule:
  - 1. Contractor may show early completion time on any schedule provided that the requirements of the contract are met.
  - 2. Contractor may increase early completion time by improving production, reallocating resources to be more efficient, performing sequential activities concurrently or by completing activities earlier than planned.
  - 3. Any time between the Contractor's early completion and the Contract Time will be considered float.
- D. Plan working durations to incorporate the effects of normal weather impacts.
  - 1. Any day lost to weather will not result in any compensation from Engineer.
  - 2. However, any day lost to weather will be granted as 1 for 1 on the Construction Schedule.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**END OF SECTION**

## **SECTION 01 33 00**

### **SUBMITTALS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Mechanics and administration of the submittal process for:
    - a. Shop Drawings.
    - b. Samples.
    - c. Informational submittals.
  - 2. General content requirements for Shop Drawings.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Construction Progress Schedule submittal requirements are specified in Specification Section 01 32 17.
  - 3. Operations and Maintenance Manual submittal requirements are specified in Specification Section 01 33 04.
  - 4. Technical Specification Sections identifying required submittals.

##### **1.2 DEFINITIONS**

- A. Shop Drawings:
  - 1. Product data and samples are Shop Drawing information.
- B. Informational Submittals:
  - 1. Submittals other than Shop Drawings and samples required by the Contract Documents that do not require review and/or approval by the Engineer.
  - 2. Representative types of informational submittal items include but are not limited to:
    - a. HVAC test and balance reports.
    - b. Installed equipment and systems performance test reports.
    - c. Manufacturer's installation certification letters.
    - d. Instrumentation and control commissioning reports.
    - e. Warranties.
    - f. Service agreements.
    - g. Construction photographs.
    - h. Survey data.
    - i. Health and safety plans.
    - j. Work plans.
    - k. Delegated designs per performance specification requirements
  - 3. For-Information-Only submittals upon which the Engineer is not expected to conduct review or take responsive action may be so identified in the Contract Documents.

##### **1.3 SUBMITTAL SCHEDULE**

- A. Schedule of Shop Drawings:
  - 1. Submitted and approved within 20 days of receipt of Notice to Proceed.
  - 2. Account for multiple transmittals under any specification section where partial submittals will be transmitted.
- B. Shop Drawings: Submittal and approval prior to 30 percent completion of project.
- C. Informational Submittals:
  - 1. Reports and installation certifications submitted within seven (7) days of conducting testing, installation, or examination.

2. Submittals showing compliance with required qualifications submitted twenty (20) days prior to any work beginning using the subject qualifications.

D. The submittal schedule shall include the following columns as a minimum:

Submittal Section	Submittal Description	Planned Submittal Date	Submittal Need Date	Actual Submittal Date	Actual Return Date	Disposition

#### 1.4 PREPARATION OF SUBMITTALS

A. General:

1. All submittals and all pages of all copies of a submittal shall be completely legible.
2. Submittals which, in the Engineer's sole opinion, are illegible will be returned without review.
3. Minimize extraneous information for equipment and products not relevant to the submittal.
4. Contractors or vendors written comments on the submittal drawings shall be in green

B. Shop Drawings, Product Data, and Samples:

1. Scope of any submittal and letter of transmittal:
  - a. Limited to one (1) Specification Section.
  - b. Submittals with more than one Specification section included will be rejected.
  - c. Do not submit under any Specification Section entitled (in part) "Basic Requirements" unless the product or material submitted is specified, in total, in a "Basic Requirements" Specification Section.
2. Numbering letter of transmittal:
  - a. Include as prefix the Specification Section number followed by a series number, "-xx", beginning with "01 IN and increasing sequentially with each additional transmittal for that Specification Section.
  - b. If more than one (1) submittal under any Specification Section, assign consecutive series numbers to subsequent transmittal letters.
3. Describing transmittal contents:
  - a. Provide listing of each component or item in submittal capable of receiving an independent review action.
  - b. Identify for each item:
    - 1) Manufacturer and Manufacturer's Drawing or data number.
    - 2) Contract Document tag number(s).
    - 3) Unique page numbers for each page of each separate item.
  - c. When submitting "or-equal" items that are not the products of named manufacturers, include the words "or-equal" in the item description.
4. Contractor certification of review and approval:
  - a. Execute Exhibit AA, Contractor's Submittal Certification form, to indicate Contractor has reviewed and approved the submittal contents.
    - 1) Clearly identify the person who reviewed the submittal and the date it was reviewed."
  - b. Submittals containing multiple independent items shall be prepared with each item listed on the letter of transmittal or on an index sheet for all items listing the discrete page numbers for each page of each item, which shall be stamped with the Contractor's review and approval stamp.
    - 1) Each independent item shall have a cover sheet with the transmittal number and item number recorded.
    - 2) Individual pages or sheets of independent items shall be numbered in a manner that permits the entire contents of a particular item to be readily recognized and associated with Contractor's certification.

5. Resubmittals:
  - a. Number with original Specification Section and series number with a suffix letter starting with "A" on a (new) duplicate transmittal form.
  - b. Do not increase the scope of any prior transmittal.
  - c. Provide cover letter indicating how each "B", "C", or "D" Action from previous submittal was addressed and where the correction is found in the resubmittal.
  - d. Account for all components of prior transmittal.
    - 1) If items in prior transmittal received "A" or "B" Action code, list them and indicate "A" or "B" as appropriate.
      - a) Do not include submittal information for items listed with prior "A" or "B" Action in resubmittal.
    - 2) Indicate "Outstanding-To Be Resubmitted at a Later Date" for any prior "C" or "D" Action item not included in resubmittal.
      - a) Obtain Engineer's approval to exclude items.
6. Do not use red color for marks on transmittals.
  - a. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible.
  - b. Engineer will use red marks or enclose marks in a cloud.
7. Transmittal contents:
  - a. Coordinate and identify Shop Drawing contents so that all items can be easily verified by the Engineer.
  - b. Provide submittal information or marks defining specific equipment or materials utilized on the Project.
    - 1) Generalized product information, not clearly defining specific equipment or materials to be provided, will be rejected.
  - c. Identify equipment or material project use, tag number, Drawing detail reference, weight, and other Project specific information.
  - d. Provide sufficient information together with technical cuts and technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Contract Documents.
  - e. Do not modify the manufacturer's documentation or data except as specified herein.
  - f. Submit items such as equipment brochures, cuts of fixtures, product data sheets or catalog sheets not exceeding 11 x 17 IN pages.
    - 1) Indicate exact item or model and all options proposed by arrow and leader.
  - g. When a Shop Drawing submittal is called for in any Specification Section, include as appropriate, scaled details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout Drawings, rough-in diagrams, wiring diagrams, controls, weights and other pertinent data in addition to information specifically stipulated in the Specification Section.
    - 1) Arrange data and performance information in format similar to that provided in Contract Documents.
    - 2) Provide, at minimum, the detail specified in the Contract Documents.
  - h. If proposed equipment or materials deviate from the Contract Drawings or Specifications in any way, clearly note the deviation and justify the said deviation in detail in a separate letter immediately following transmittal sheet. Any deviation from plans or specifications not depicted in the submittal or included but not clearly noted by the Contractor may not have been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility for any error or deviation from contract requirements.
8. Samples:
  - a. Identification:
    - 1) Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, Specification Section or Drawing detail reference, color, range, texture, finish and other pertinent data.

- 2) If identifying information cannot be marked directly on sample without defacing or adversely altering samples, provide a durable tag with identifying information securely attached to the sample.
  - b. Include application specific brochures, and installation instructions.
  - c. Provide Contractor's review and approval certification stamp or Contractor's Submittal Certification form as indication of Contractor's checking and verification of dimensions and coordination with interrelated work.
  - d. Resubmit revised samples of rejected items.
- C. Informational Submittals:
1. Prepare in the format and detail specified in Specification requiring the informational submittal.

## **1.5 TRANSMITTAL OF SUBMITTALS**

- A. Shop Drawings, Informational Submittals and Samples:
1. Transmit all submittals electronically:
  2. Utilize one (1) copy of attached Exhibit A to transmit all Shop Drawings and samples.
  3. All submittals must be from Contractor.
    - a. Submittals will not be received from or returned to subcontractors.
- B. Electronic Transmission of Submittals:
1. Transmittals shall be made electronically.
    - a. Use Newforma Project Management Environment or mutually agreeable forms
    - b. Protocols and processes will be determined at the Pre-Construction Conference.
  2. Provide documents in Adobe Acrobat Portable Document Format (PDF), latest version.
  3. Do not password protect or lock the PDF document.
  4. Drawings or other graphics must be converted to PDF file format from the original drawing file format and made part of the PDF document.
    - a. Scanning of drawings is to be used only where actual file conversion is not possible and drawings must be scanned at a resolution of 300 dpi or greater.
    - b. Required signatures may be applied prior to scanning for transmittal.
  5. Electronic drawings shall be formatted to be at full-scale (or half-scale when printed to 11x17).
    - a. Do not reduce drawings by more than 50 PCT in size.
    - b. Reduced drawings shall be clearly marked "HALF-SIZE" and shall scale accurately at that size.
  6. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is opened the sheet is in the appropriate position for viewing.
  7. Create bookmarks in the bookmarks panel for the cover, the Table of Contents, and each major section of the document.
  8. File naming conventions:
    - a. File names shall use a "ten dot three" convention (XXXXXX-YY-Z.PDF) where XXXXXX is the Specification Section number, YY is the Shop Drawing Root number and Z is an ID number used to designate the associated volume.
  9. Labeling:
    - a. As a minimum, include the following labeling on all CD-ROM discs and jewel cases:
      - 1) Project Name.
      - 2) Equipment Name and Project Tag Number.
      - 3) Project Specification Section.
      - 4) Manufacturer Name.
      - 5) Vendor Name.
  10. Binding:
    - a. Include labeled CD(s) in labeled jewel case(s).
      - 1) Bind jewel cases in standard three-ring binder Jewel Case Page(s), inserted at the front of the Final paper copy submittal.

- 2) Jewel Case Page(s) to have means for securing Jewel Case(s) to prevent loss (e.g., flap and strap).

## 1.6 REVIEW ACTION

### A. Shop Drawings and Samples:

1. Items within transmittals will be reviewed for overall design intent and will receive one (1) of the following actions:
  - a. A - FURNISH AS SUBMITTED.
  - b. B - FURNISH AS NOTED (BY Engineer).
  - c. C - REVISE AND RESUBMIT.
  - d. D - REJECTED.
  - e. E - REVIEW NOT REQUIRED.
2. Submittals will be reviewed within fifteen (15) business days of receipt.
3. Submittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp.
  - a. Submittals not stamped by the Contractor or stamped with a stamp containing language other than that specified herein will not be reviewed for technical content and will be returned rejected.
4. In relying on the representation on the Contractor's review and approval stamp, Engineer reserve the right to review and process poorly organized and poorly described submittals as follows:
  - a. Submittals transmitted with a description identifying a single item and found to contain multiple independent items:
    - 1) Review and approval will be limited to the single item described on the transmittal letter.
    - 2) Other items identified in the submittal will:
      - a) Not be logged as received by the Engineer.
      - b) Be removed from the submittal package and returned without review and comment to the Contractor for coordination, description and stamping.
      - c) Be submitted by the Contractor as a new series number, not as a re-submittal number.
  - b. Engineer, at Owners's discretion, may revise the transmittal letter item list and descriptions, and conduct review.
    - 1) Unless Contractor notifies Engineer in writing that the Engineer's revision of the transmittal letter item list and descriptions was in error, Contractor's review and approval stamp will be deemed to have applied to the entire contents of the submittal package.
5. Submittals returned with Action "A" or "B" are considered ready for fabrication and installation.
  - a. If for any reason a submittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal.
  - b. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.
6. Submittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
  - a. The portion of the submittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference).
    - 1) One (1) copy or the one (1) transparency of the "C" or "D" Drawings will be marked up and returned to the Contractor.
      - a) Correct and resubmit items so marked.
  - b. Items marked "A" or "B" will be fully distributed.
  - c. If a portion of the items or system proposed are acceptable, however, the major part of the individual Drawings or documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action.

- 1) This is at the sole discretion of the Engineer.
  - 2) In this case, some Drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package."
  - 3) Distribution to field will not be made (unless previously agreed to otherwise).
7. Failure to include any specific information specified under the submittal paragraphs of the Specifications will result in the submittal being returned to the Contractor with "C" or "D" Action.
8. Calculations required in individual Specification Sections will be received for information purposes only, as evidence calculations have been stamped by the professional as defined in the specifications and for limited purpose of checking conformance with given performance and design criteria. The Engineer is not responsible for checking the accuracy of the calculations and the calculations will be returned stamped "E. Review Not Required" to acknowledge receipt.
9. Furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges.
10. Transmittals of submittals which the Engineer considers as "Not Required" submittal information, which is supplemental to but not essential to prior submitted information, or items of information in a transmittal which have been reviewed and received "A" or "B" action in a prior submittal, will be returned with action "E. Review Not Required."
11. Samples may be retained for comparison purposes.
  - a. Remove samples when directed.
  - b. Include in bid all costs of furnishing and removing samples.
12. Approved samples submitted or constructed, constitute criteria for judging completed work.
  - a. Finished work or items not equal to samples will be rejected.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**END OF SECTION**





# EXHIBIT A Shop Drawing Transmittal No.

(Spec Section) (Series)

Project Name:		Date Received:	
Project Owner:		Checked By:	
Contractor:	HDR Engineering, Inc.	Log Page:	
Address:	Address:	HDR No.:	
		Spec Section:	
		Drawing/Detail No.:	
Attn:	Attn:	1st. Sub	ReSub.
Date Transmitted:		Previous Transmittal Date:	

Item No.	No. Copies	Description	Manufacturer	Mfr/Vendor Dwg or Data No.	Action Taken*

Remarks:

\* The Action designated above is in accordance with the following legend:

A - Furnish as Submitted B - Furnish as Noted C - Revise and Submit 1. Not enough information for review. 2. No reproducibles submitted. 3. Copies illegible. 4. Not enough copies submitted. 5. Wrong sequence number. 6. Wrong resubmittal number. 7. Wrong spec. section. 8. Wrong form used. 9. See comments. D - Rejected	E - Engineer's review not required 1. Submittal not required. 2. Supplemental Information. Submittal retained for informational purposes only. 3. Information reviewed and approved on prior submittal. 4. See comments. 5. Delegated Design - Submittal received as requested by the Contract Documents. The Engineer did not review the engineering or technical content of the submittal.  Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Any deviation from plans or specifications not depicted in the submittal or included but not clearly noted by the Contractor may not have been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility for any error or deviation from contract requirements.
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Comments:

By		Date			
Distribution:	Contractor	File	Field	Owner	Other



EXHIBIT AA

## Contractor's Submittal Certification

Shop Drawing Transmittal No.:

Contract/Project Name:

Company Name:

has

1. reviewed and coordinated this Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
2. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
3. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

- ☐ This Submittal **does not** contain any variations from the requirements of the Contract Documents.
- ☐ This Submittal **does** contain variations from the requirements of the Contract Documents. A separate description of said variations and a justification for them is provided in an attachment hereto identified as:

"Shop Drawing Transmittal No. \_\_\_\_\_ Variation and Justification Documentation"

Insert picture file or electronic signature of Authorized Representative

\_\_\_\_\_  
Authorized Representative

\_\_\_\_\_  
Date



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**SECTION 01 33 04**  
**OPERATION AND MAINTENANCE MANUALS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Administration of the submittal process for Operation and Maintenance Manuals.
  - 2. Content requirements for Operation and Maintenance Manuals.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. General submittal requirements are specified in Specification Section 01 33 00 - Submittals.
  - 3. Technical Specification Sections identifying required Operation and Maintenance Manual submittals.

**1.2 DEFINITIONS**

- A. Equipment Operation and Maintenance Manuals:
  - 1. Contain the technical information required for proper installation, operation and maintenance of process, electrical and mechanical equipment and systems.
- B. Building Materials and Finishes Operation and Maintenance Manuals:
  - 1. Contain the information required for proper installation and maintenance of building materials and finishes.

**1.3 SUBMITTALS**

- A. List of all the Operation and Maintenance Manuals required by the Contract as identified in the Technical Specification Sections. These may be referred to as "Operation and Maintenance Data" submittals.
- B. Operation and Maintenance Manuals:
  - 1. Draft and final electronic copies.
  - 2. Final paper copies: Two (2).

**1.4 SUBMITTAL SCHEDULE**

- A. List of Required Operation and Maintenance Manuals:
  - 1. Submit list with Specification Section number and title within 90 days after Notice to Proceed.
- B. Draft Operation and Maintenance Manuals:
  - 1. Submit approvable draft manuals in electronic format (PDF) within 30 days following approval of the respective Shop Drawing.
    - a. Include placeholders or fly sheet pages where information is not final or is missing from the draft manual.
  - 2. All Draft Operation and Maintenance Manuals shall be received by no later than 75 PCT project completion.
- C. Final Operation and Maintenance Manuals:
  - 1. Final approval of Operation and Maintenance Manuals in electronic format (PDF) must be obtained 45 days prior to equipment start-up.
  - 2. Provide paper copies and CD-ROMs/flash drive of approved final Operation and Maintenance Manuals in electronic format (PDF), a minimum of 30 days prior to equipment start-up.
  - 3. Issue addenda to Final Approved Operation and Maintenance Manual to include:

- a. Equipment data that requires collection after start-up, for example but not limited to HVAC balancing reports, electrical switchgear, automatic transfer switch and circuit breaker settings.
- b. Equipment field testing data.
- c. Equipment start-up reports.

## 1.5 PREPARATION OF SUBMITTALS

### A. General:

- 1. All pages of the Operation and Maintenance Manual submittal shall be legible.
  - a. Submittals which, in the Engineer's sole opinion, are illegible will be rejected without review.
- 2. Identify each equipment item in a manner consistent with names and identification numbers used in the Contract Documents, not the manufacturer's catalog numbers.
- 3. Neatly type any data not furnished in printed form.
- 4. Operation and Maintenance Manuals are provided for USER's use, to be reproduced and distributed as training and reference materials within USER's organization.
  - a. This requirement is:
    - 1) Applicable to both paper copy and electronic files.
    - 2) Applicable to materials containing copyright notice as well as those with no copyright notice.
- 5. Notify supplier and/or manufacturer of the intended use of Operations and Maintenance Manuals provided under the Contract.

### B. Operation and Maintenance Manual Format and Delivery:

- 1. Draft electronic submittals:
  - a. Provide manual in Adobe Acrobat Portable Document Format (PDF), latest version.
  - b. Create one (1) PDF file for each equipment Operation and Maintenance Manual.
  - c. Do not password protect or lock the PDF document.
  - d. Scanned images of paper documents are not acceptable. Create the Operation and Maintenance Manual PDF file from the original source document.
  - e. Drawings or other graphics must be converted to PDF file format from the original drawing file format and made part of the PDF document.
  - f. Scanning of drawings is to be used only where actual file conversion is not possible and drawings must be scanned at a resolution of 300 dpi or greater.
  - g. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is opened the sheet is in the appropriate position for viewing.
  - h. Create bookmarks in the bookmarks panel for the Operation and Maintenance Manual cover, the Table of Contents and each major section of the Table of Contents.
  - i. PDF file naming convention:
    - 1) Use the Specification Section number, the manufacturer's name and the equipment description, separated by underscores.
    - 2) Example: 46 51 21\_Sanitaire\_Coarse\_Bubble\_Diffusers.pdf.
    - 3) Do not put spaces in the file name.
- 2. Final electronic submittals:
  - a. Submit two (2) copies in PDF file format on two (2) CD-ROM discs (one (1) copy per CD-ROM), each secured in a jewel case or on a flash drive.
  - b. CD-ROM Labeling:
    - 1) Provide the following printed labeling on all CD-ROM discs:
      - a) Project name.
      - b) Specification Section.
      - c) Equipment names and summary of tag(s) covered.
      - d) Manufacturer name.
      - e) Date (month, year).

- c. CD-ROM Jewel Case Holder:
    - 1) Insert jewel cases containing labeled CD-ROM discs in three-ring binder holder (C-Line Products, [www.c-lineproducts.com](http://www.c-lineproducts.com) stock number CLI-61968 or equivalent) at the front of each final paper copy.
- 3. Final paper copy submittals:
  - a. Quantity: Provide two (2) copies.
  - b. Paper: 8.5 x 11 IN or 11 x 17 IN bright white, 20 LB paper with standard three-hole punching.
  - c. 3-Ring Binder:
    - 1) Provide D-ring binder with clear vinyl sleeves (i.e. view binder) on front and spine.
    - 2) Insert binder title sheet with the following information under the front and spine sleeves:
      - a) Project name.
      - b) Specification Section.
      - c) Equipment names and summary of tag(s) covered.
      - d) Manufacturer name.
      - e) Date (month, year).
    - 3) Provide plastic sheet lifters prior to first page and following last page.
  - d. Drawings:
    - 1) Provide all drawings at 11 x 17 IN size, triple folded and three-hole punched for insertion into manual.
    - 2) Where reduction is not practical to ensure readability, fold larger drawings separately and place in three-hole punched vinyl envelopes inserted into the binder.
    - 3) Identify vinyl envelopes with drawing numbers.
  - e. Use plastic coated dividers to tab each section of each manual in accordance with the Table of Contents.
- C. Equipment Operation and Maintenance Manual Content:
  - 1. Provide a cover page as the first page of each manual with the following information:
    - a. Manufacturer(s) Name and Contact Information.
    - b. Vendor's Name and Contact Information.
    - c. Date (month, year).
    - d. Project USER and Project Name.
    - e. Specification Section.
    - f. Project Equipment Tag Numbers.
    - g. Model Numbers.
    - h. Engineer's Name.
    - i. Contractor's Name.
  - 2. Provide a Table of Contents for each manual.
  - 3. Provide Equipment Record sheets as follows:
    - a. Printed copies of the Equipment Record (Exhibits B1, B2 and B3), as the first tab following the Table of Contents.
    - b. Exhibits B1-B3 are available as Fillable PDF Form documents from the Engineer.
    - c. Each section of the Equipment Record must be completed in detail; simply referencing the related equipment Operation and Maintenance Manual sections for nameplate, maintenance, spare parts or lubricant information is not acceptable.
    - d. For equipment involving separate components (for example, a motor and gearbox), a fully completed Equipment Record is required for each component.
    - e. Submittals that do not include the Equipment Record(s) will be rejected without further content review.
  - 4. Provide a printed copy of the Manufacturer's Field Services report as required by Specification Section 01 75 00 following the Equipment Record sheets.
  - 5. Provide the following detailed information, as applicable:
    - a. Use equipment tag numbers from the Contract Documents to identify equipment and system components.

- b. Equipment function, normal and limiting operating characteristics.
  - c. Instructions for assembly, disassembly, installation, alignment, adjustment, and inspection.
  - d. Operating instructions for start-up, normal operation, control, shutdown, and emergency conditions.
  - e. Lubrication and maintenance instructions.
  - f. Troubleshooting guide.
  - g. Mark each sheet to clearly identify specific products and component parts and data applicable to the installation for the Project; delete or cross out information that does not specifically apply to the Project.
  - h. Parts lists:
    - 1) A parts list and identification number of each component part of the equipment.
    - 2) Exploded view or plan and section views of the equipment with a detailed parts callout matching the parts list.
    - 3) A list of recommended spare parts.
    - 4) List of spare parts provided as specified in the associated Specification Section.
    - 5) A list of any special storage precautions which may be required for all spare parts.
  - i. General arrangement, cross-section, and assembly drawings.
  - j. Electrical diagrams, including elementary diagrams, wiring diagrams, connection diagrams, and interconnection diagrams.
  - k. Test data and performance curves.
  - l. As-constructed fabrication or layout drawings and wiring diagrams.
  - m. Copy of the equipment manufacturer's warranty meeting the requirements of the Contract.
  - n. Copy of any service contracts provided for the specific piece of equipment as part of the Contract.
6. Additional information as required in the associated equipment or system Specification Section.
- D. Building Materials and Finishes Operation and Maintenance Manual Content:
- 1. Provide a cover page as the first page of each manual with the following information:
    - a. Manufacturer(s) Name and Contact Information.
    - b. Vendor's Name and Contact Information.
    - c. Date (month, year).
    - d. Project USER and Project Name.
    - e. Specification Section.
    - f. Model Numbers.
    - g. Engineer's Name.
    - h. Contractor's Name.
  - 2. Provide a Table of Contents for each manual.
  - 3. Building products, applied materials and finishes:
    - a. Include product data, with catalog number, size, composition and color and texture designations.
    - b. Provide information for ordering custom manufactured products.
  - 4. Necessary precautions:
    - a. Include product MSDS for each approved product.
    - b. Include any precautionary application and storage guidelines.
  - 5. Instructions for care and maintenance:
    - a. Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.
  - 6. Moisture protection and weather exposed products:
    - a. Include product data listing, applicable reference standards, chemical composition, and details of installation.
    - b. Provide recommendations for inspections, maintenance and repair.



7. Additional requirements as specified in individual product specifications.
- E. National Fire Protection Association 70 (National Electrical Code) Documentation:
  1. Assemble documented calculations of Arc-Fault Current, Equipment Available Fault Current and Short Circuit Current Rating (SCCR) provided as part of equipment submittals into one O&M manual volume.

## **1.6 TRANSMITTAL OF SUBMITTALS**

- A. Operation and Maintenance Manuals.
  1. Transmit all submittals to:
    - a. The address specified in Specification Section 01 33 00 - SUBMITTALS.
  2. Transmittal form: Use Operation and Maintenance Manual Transmittal, Exhibit A.
  3. Transmittal numbering:
    - a. Number each submittal with the Specification Section number followed by a series number beginning with "-01 IN and increasing sequentially with each additional transmittal, followed by "-OM" (for example: 43 23 14-01-OM).
  4. Submit draft and final Operation and Maintenance Manual in electronic format (PDF) to Engineer, until manual is approved.

## **1.7 REVIEW ACTION**

- A. Draft Electronic (PDF) Submittals:
  1. Engineer will review and indicate one of the following review actions:
    - a. A - ACCEPTABLE
    - b. B - FURNISH AS NOTED
    - c. C - REVISE AND RESUBMIT
    - d. D - REJECTED
  2. Submittals marked as Acceptable or Furnish As Noted will be retained; however, the transmittal form will be returned with a request for the final paper and electronic documents to be submitted.
  3. Copies of submittals marked as Revise and Resubmit or Rejected will be returned with the transmittal form marked to indicate deficient areas.
  4. Resubmit until approved.
- B. Final Paper Copy Submittals:
  1. Engineer will review and indicate one (1) of the following review actions:
    - a. A - ACCEPTABLE
    - b. D - REJECTED
  2. Submittals marked as Acceptable will be retained with the transmittal form returned as noted.
  3. Submittals marked as Rejected will be returned with the transmittal form marked to indicate deficient areas.
  4. Resubmit until approved.

## **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **END OF SECTION**

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EXHIBIT A **Operation and Maintenance Manual**  
**Transmittal** \_\_\_\_\_ - \_\_\_\_\_ - OM  
**(Spec Section) (Series)** \_\_\_\_\_.

Project Name:		Date Received:
Project Owner:		Checked By:
Contractor:	Owner:	Log Page:
Address:	Address:	HDR No.:
Attn:	Attn:	1st. Sub. ReSub.

Date Transmitted:	Previous Transmittal Date:			
No. Copies	Description of Item	Manufacturer	Dwg. or Data No.	Action Taken*

Remarks:

To:	From: <i>HDR Engineering, Inc.</i>
	Date:

- \* The Action designated above is in accordance with the following legend:
- |   |   |
|---|---|
| A - Acceptable, provide one (1) additional paper copy and two (2) electronic copies on CD-ROM for final review. | 5. Lubrication & maintenance instructions.                |
| B - <del>Furnish as Noted</del> - Not Used  | 6. Troubleshooting guide.                                 |
| C - Revise and Resubmit   | 7. Parts list and ordering instructions.                  |
| This Operation and Maintenance Manual Submittal is deficient in the following area:                             | 8. Organization (binder, binder titles, index & tabbing). |
| 1. Equipment Records.   | 9. Wiring diagrams & schematics specific to installation. |
| 2. Functional description.  | 10. Outline, cross section & assembly diagrams.           |
| 3. Assembly, disassembly, installation, alignment, adjustment & checkout instructions.                          | 11. Test data & performance curves.                       |
| 4. Operating instructions.  | 12. Tag or equipment identification numbers.              |
|   | 13. Inclusion of all components & subcomponents.          |
|   | 14. Other - see comments.                                 |
- D - ~~Rejected~~ - Not Used

Comments:





\* D = Daily      W = Weekly      M = Monthly      Q = Quarterly      S = Semiannual      A = Annual      Hours = Run Time I

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## EXHIBIT B3

## Equipment Record

## Lubrication Summary

Equipment Description	Project Equip. Tag No(s).
-----------------------	---------------------------

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					

	5				
--	---	--	--	--	--

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## **SECTION 01 35 73**

### **DELEGATED DESIGN PROCEDURES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
1. General provisions for delegated design services.
  2. Coordination of delegated designs with other Work.
  3. Qualifications requirements for delegated design professionals.
  4. Limitations on Engineer's review of delegated design Submittals.
  5. Responsibilities of delegated design professionals.
- B. Scope:
1. Where delegated design is specifically Contractor's responsibility in accordance with the Contract Documents, Contractor shall provide labor, services, other effort, and pay all costs necessary and required to perform delegated design services for Work that will be part of the completed Project as a functioning whole.
  2. Perform delegated design Work in accordance with the Contract Documents, delegated design Action Submittals approved by Engineer, and Shop Drawings, product data Submittals, and Samples approved by the associated delegated design professional.
  3. Contractor's correction period, general warranty and guarantee, and obligations for safety and protection apply to delegated design Work to the same extent such provisions apply to all other Work under the Contract.
  4. Specifications requiring delegated design services include, but are not necessarily limited to, the following:
    - a. Section 03 15 19 - Anchorage to Concrete.
    - b. Section 05 50 00 - Metal Fabrications.
    - c. Section 05 52 43 - Welded Aluminum Railings.
  5. Not Delegated Design: The following are not delegated design and are not covered by this Section:
    - a. Contractor's use of design professionals for: (1) temporary construction or temporary facilities not part of the completed Project as a functioning whole, or (2) Contractor's means, methods, procedures, techniques, and sequences of construction and safety and protection measures incident thereto. Requirements applicable to such professional services are in Section 01 71 23 - Field Engineering.
    - b. Certain final designs that, in accordance with commonly accepted practice, are typically prepared by unlicensed, unregistered individuals, including for manufactured or fabricated systems, components or assemblies, not acting under the supervisory control of the design professional in responsible charge, but who commonly possess appropriate certification from a relevant industry organization, together with appropriate training and experience.
- C. Related Requirements:
1. Sections of Divisions 02-49 where delegated design Work is required.

##### **1.2 REFERENCES**

- A. Terminology:
1. Terminology indicated below are not defined terms and are not indicated with initial capital letters but, when used in this Section and Specifications of Division 02-49 where delegated design Work is required, have the meaning indicated below:
    - a. "Delegated design" means preparing the final design of part of the completed, permanent Work by one or more delegated design professionals, in accordance with the Contract Documents. The terms "delegated design", "delegated design services",

“delegation of design responsibility”, and similar or derivative terms have the same meaning.

- b. “Delegated design professional” means the licensed and registered engineer, architect, geologist, or other design professional retained by or employed by Contractor, Subcontractor, or Supplier to perform delegated design services for delegated design Work and possessing appropriate experience and qualifications for such delegated design services.
- c. “Delegated design Work” means delegated design services, associated construction, and related Work.
- d. “Instruments of service”, relative to delegated designs, means delegated design professional’s: (1) certifications (including delegated design professional’s certification of compliance, as required in this Section, and other certifications required of delegated design professional), (2) reports (where required), (3) design drawings, (4) design specifications, (5) other documents specifically indicated as delegated design professional’s “instruments of service” in the Contract Documents, and (6) documents modifying a delegated design (after Engineer’s approval of the original delegated design Submittals). “Instruments of service” are to be sealed, signed, and dated by delegated design professional and expressly required as Submittals. Shop Drawings sealed and signed by delegated design professional are delegated design professional’s “instruments of service”.

### **1.3 GENERAL PROVISIONS CONCERNING DELEGATED DESIGN SERVICES**

#### **A. Delegated Designs - General:**

- 1. This Section augments the requirements of the General Conditions, as may be amended by the Supplementary Conditions, and other provisions of the Contract Documents regarding Contractor’s responsibilities for delegated design Work.
- 2. Delegated design professionals or their employer shall furnish professional liability insurance. Provisions on professional liability insurance are set forth in the Supplementary Conditions. Submit through Contractor appropriate documentation of professional liability insurance.

### **1.4 ADMINISTRATIVE REQUIREMENTS**

#### **A. Coordination:**

- 1. Coordination - General:
  - a. Contractor shall coordinate the services of delegated design professionals with all other elements of the Work.
  - b. Contractor has full responsibility for scheduling delegated designs and all related Work.
  - c. Allow sufficient time in Progress Schedule for performance of delegated design services, including requests for interpretation or clarification between delegated design professional and Contractor and between Contractor and Engineer.
- 2. Coordination of Delegated Design Work’s Connections to Other Work:
  - a. Where delegated design Work connects to other Work designed by Engineer, existing construction, or both, the delegated design Work shall be consistent with the other Work and existing construction to which delegated design Work connects, and adjacent construction.
  - b. Submit details, loading, anchorage, and other coordinating information necessary for the delegated design Work to properly interface with Work designed by Engineer.
  - c. Changes in the Work, whether designed by Engineer, designed by delegated design professional, or existing construction, necessary as a result of the delegated design are ineligible for increase in Contract Price or Contract Times, unless: (1) otherwise agreed by both Engineer and Owner, or (2) expressly indicated otherwise elsewhere in the Contract Documents for the associated delegated design Work.
  - d. Changes requiring extra compensation, time, or both arising from delegated design aspects needed for convenience of Contractor, Subcontractor, or Supplier, are not grounds for increase in Contract Price or Contract Times.

3. Coordination of Submittals, Fabrication, Production, and Shipment:
  - a. Do not release for raw materials procurement, fabrication, production, and shipment to the Site materials, equipment, or systems designed by delegated design professional until the associated delegated design professional has reviewed and approved all associated Shop Drawings, product data, Samples, and (relative to shipment) source quality control Submittals, and such Submittals have been delivered to and accepted by Engineer.
  - b. Allow sufficient time in the Progress Schedule for required Submittals and required actions by delegated design professionals and Engineer.

## **1.5 QUALITY ASSURANCE**

- A. Qualifications:
  1. Delegated Design Professionals:
    - a. Each delegated design professional shall possess not less than the minimum qualifications set forth in this provision. Where the Specifications for the associated delegated design Work establish more-stringent qualifications requirements, comply with the more-stringent requirements.
    - b. Each delegated design professional shall comply with all of the following:
      - 1) Legally qualified, as both an individual and as a business entity, to practice the associated design discipline(s) in the jurisdiction where the Site is located, including possessing current, valid license and registration for the design discipline(s) for which the delegated design professional will render its services on the Project.
      - 2) Possess not less than five years of experience in the subject design discipline(s).
      - 3) Served as design professional in responsible charge on not less than five other designs similar in scope and complexity to the Work for which delegated design professional is retained on the Project; construction of such prior projects shall be complete by the start of the Project's construction.
    - c. Summary of Qualifications: Submit to Engineer summary of delegated design professional's experience and qualifications, including:
      - 1) Evidence of coverage under appropriate professional liability insurance in accordance with the Contract Documents.
      - 2) Evidence of delegated design professional's ability to legally conduct business as a design professional in the same jurisdiction as the Site, as a business entity.
      - 3) Copy of delegated design professional's current, valid personal design professional license and registration for the same jurisdiction as the Site. Such documents shall indicate the individual's name, license or registration number, and dates for which the license or registration is valid.
      - 4) Other information reasonably requested by Engineer.

## **1.6 GENERAL PROVISIONS FOR DELEGATED DESIGN SUBMITTALS**

- A. Under the Division 02-49 Specifications section(s) where delegated design Work is required, furnish to Engineer Submittals such as:
  1. Action Submittals:
    - a. Delegated design professional's instruments of service Submittals.
  2. Informational Submittals:
    - a. When delivered to Engineer, the following must bear delegated design professional's Submittal approval stamp:
      - 1) Shop Drawings, product data Submittals, Samples, testing plans.
      - 2) Results of source quality control and field quality control activities.
    - b. Delegated design professional's calculations.
    - c. Other Informational Submittals required for the subject delegated design Work.
- B. Limitations of Engineer's Review of Delegated Design Submittals:
  1. Delegated Design Professional's Instruments of Service Submittals:

- a. Engineer's review of delegated design instruments of service Submittals is for the limited purposes indicated in this Section's "General Provisions Concerning Delegated Designs" Article.
  - b. The following disclaimer applies to Engineer's responses to delegated design professional's instruments of service Submittals:
    - 1) Engineer's review and approval of delegated design instruments of service is only for the limited purpose of verifying that performance and design criteria given in the Contract were used in the delegated design, and checking for compliance with the Engineer's design concept expressed in the Contract Documents.
    - 2) Contractor is solely responsible for complying with: the Contract Documents, Subcontractor and Supplier instructions consistent with the Contract Documents, Owner's directions, and Laws and Regulations.
    - 3) Contractor is solely responsible for obtaining, correlating, confirming, and correcting dimensions at the Site; quantities; information and choices pertaining to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the Work of all trades.
    - 4) Engineer is not responsible for the effects of resubmittals or tracking progress of resubmittals.
2. Delegated Design Informational Submittals:
- a. Other provisions of the Contract Documents notwithstanding, Engineer's review of delegated design Informational Submittals is limited to only:
    - 1) Verifying the Submittal was furnished as required; and
    - 2) Submittal generally appears complete (except for calculations); and
    - 3) Submittal bears delegated design professional's approval stamp; or, for calculations prepared by or for delegated design professional, that such calculations bear delegated design professional's seal, signature, and date; or, for delegated design professional's reports of visits to the Site, that such report is legible, and bears delegated design professional's signature with date.
  - b. Engineer receives such Submittals, including delegated design professional's calculations, on behalf of Owner, for Owner's records.
  - c. Engineer, Owner, and others involved in the Project have the right to rely on delegated design professional's approval stamp as meaning that the delegated design professional has performed and appropriate review of the Submittal and determined it to be complete, in accordance with delegated design professional's instruments of service approved by Engineer, in accordance with delegated design professional's design intent, and in accordance with the Contract Documents.
3. Engineer's Other Comments on Delegated Design Submittals:
- a. Despite the limitations of Engineer's review of Submittals for delegated design Work, should Engineer become aware of, or reasonably suspect existence of, potential of associated delegated design Work to adversely affect health, safety, or welfare of persons, or pose reasonable potential for damage to the Work, work of other contractors, or adjacent property, Engineer will advise Contractor in writing of general nature of Engineer's concern.
  - b. Such advisory by Engineer, if issued, is rendered in good faith and does not in any way constitute:
    - 1) Engineer's review of all aspects of the delegated design.
    - 2) Any sharing by Engineer of any of delegated design professional's responsibilities or professional liability.
    - 3) Any responsibility imposed, in any way, on Engineer for any aspect of the delegated design professional's services or design, beyond the limited purposes of Engineer's review as set forth in the Contract Documents. .
  - c. Contractor and its Subcontractors and Suppliers, including delegated design professionals, shall immediately investigate Engineer's concern indicated in such advisory and remedy as necessary and required.

- d. Neither Engineer nor Owner, nor their respective consultants and subcontractors, is obligated to review any Submittal for delegated design Work beyond the limited review required by the Contract Documents. No such advisory, if issued, entitles Contractor, Subcontractor, or Supplier, including delegated design professionals, to rely on such advisory or to assume that any further such reviews or written or oral advisories are forthcoming.

## **1.7 RESPONSIBILITIES OF DELEGATED DESIGN PROFESSIONALS**

### **A. Standard of Care:**

- 1. Unless a higher standard of care is established by the Division 02-49 Specifications section where the associated delegated design Work is required, the delegated design services shall comply with the following standard of care:
  - a. Except as provided in the paragraph immediately above this, the standard of care for all delegated design professional services and related services performed or furnished by delegated design professionals for the Project will be the care and skill ordinarily used by members of the subject profession practicing under similar circumstances at the same time and in the same locality.

### **B. Responsibilities of delegated design professionals employed on the Work include, but are not necessarily limited to, the following, unless specifically indicated otherwise in the associated elements of the Contract Documents where the delegated design is required:**

- 1. **Ethical Conduct and Professionalism:** Comply with Laws and Regulations and applicable standards and guidelines relevant design professional organizations for ethical conduct and professional practice.
- 2. Comply with Laws and Regulations and relevant design standards applicable to the subject delegated design Work.
- 3. **Performance and Design Criteria Indicated in the Contract Documents and Other Information:**
  - a. Review performance and design criteria, indicated in the Contract Documents, that the delegated design Work must satisfy.
  - b. Prepare written requests for interpretations or clarifications of performance or design criteria.
  - c. Review existing information about the Site that constitutes Technical Data (if any, applicable to the subject delegated design Work), as indicated in the Supplementary Conditions.
- 4. **Site Information and Investigations:** With Contractor, obtaining all other necessary dimensions, field information, and other information necessary for preparing delegated design Submittals.
- 5. **Design and Other Professional Services:** Personally perform and prepare, or actively exercise direct, personal, supervisory control over others performing or preparing:
  - a. Necessary design professional evaluations of conditions, materials, and equipment.
  - b. Prepare the instruments of service Submittals and calculations Submittal for the subject delegated design Work, where required by the associated Division 02-49 Specifications and other, associated Contract Documents.
  - c. Assist Contractor with applying for and obtaining permits and approvals (not previously obtained by Owner or those for whom Owner is responsible) necessary for the delegated design Work.
  - d. Review and approve or take other appropriate action on Shop Drawings (unless such Shop Drawings are sealed and signed by delegated design professional), product data, Samples, and testing plans, and other Submittals associated with the delegated design Work.
  - e. Prepare modifications of the delegated design instruments of service as necessary.
- 6. **Sealing and Signing:**

- a. Seal, sign, and indicate date of sealing and signing, on all of the following when such Submittals are required by the Division 02-49 Specifications where the delegated design Work is required:
    - 1) Instruments of service Submittals, including certification of compliance required.
    - 2) Calculations.
    - 3) Modifications to the delegated design.
    - 4) Other documents required to be sealed and signed by Laws or Regulations or the Contract Documents.
  - b. Sealing and signing documents in accordance with Laws and Regulations and the Contract Documents, prior to submittal (through Contractor) to Engineer, and for submittal to authorities having jurisdiction to obtain necessary permits and approvals.
  - c. Sealing and signing shall be in accordance with Laws and Regulations.
7. Certification of Compliance by Delegated Design Professional:
- a. Schedule:
    - 1) Submit certification of compliance after Engineer's acceptance of delegated design professional's qualifications statement.
    - 2) Obtain Engineer's approval of certificate of compliance Submittal prior to furnishing other Submittals for delegated design Work under the same Specifications section, unless otherwise allowed by Engineer.
  - b. Through Contractor, submit to Engineer, delegated design professional's written certification indicating:
    - 1) General Information: (1) Project name and designation, (2) Contractor name and Contract designation, (3) Subcontractor or Supplier name (when applicable), (4) full name of delegated design professional's business entity under which the delegated design services were performed, (5) full name and license number of the individual sealing and signing the subject delegated design Work, (6) specific elements of delegated design Work to which the certification applies, and (7) delegated design professional's seal, signature, and date of signature.
    - 2) Explicit certification that the subject delegated design complies with:
      - a) All applicable performance and design criteria indicated in the Contract Documents. Expressly indicate on certification of compliance the specific performance and design criteria used in the delegated design, and reaction forces of the delegated design imparted to other Work and existing construction. Reaction forces imparted from the delegated design elements to the Engineer's designed system shall include the following:
        - (1) Unfactored loads for each of the following load categories: dead, live, wind, seismic, and other types of loading required in the Specifications section where the associated delegated design Work is required.
        - (2) Load combinations presented in Load Factor Resistance Design (LRFD) format from each element transmitting load.
      - b) All Laws and Regulations.
      - c) Applicable design standards commonly applicable to such types of construction. Expressly indicate such design standards on the certification of compliance.
      - d) The applicable standard of care. Expressly indicate the applicable standard of care.
8. Approvals of Other Delegated Design Submittals:
- a. Review and taking appropriate action on Submittals for delegated designs:
  - b. Such reviews and approvals or other appropriate action shall be to ascertain compliance with:
    - 1) Delegated design professional's design intent.
    - 2) Delegated design professional's instruments of service and calculations.
    - 3) Associated requirements of the Contract Documents.
  - c. Delegated design professional's review stamp or facsimile thereof, review action or disposition concerning the associated Submittal for the delegated design, date of

- review, and name of person performing the review shall be clearly legible on the associated Submittals (except for delegated design professional's own instruments of service Submittals, calculations, and reports of delegated design professional's visits to the Site). Prominently display delegated design professional's Submittal review stamp or facsimile thereof on: (1) each sheet of Shop Drawings, (2) each major section of product data Submittals, (3) each Sample, (4) each testing plan, and (5) each other Submittal associated with the delegated design for which such review stamp is required.
- d. Do not apply delegated design professional's Submittal review stamp and comments, if any, over other text, tables, or graphics.
  - e. Where review stamp or facsimile thereof is required, submit to Engineer only those Submittals for delegated design Work that bear delegated design professional's explicit approval of the Submittal.
9. Respond promptly to requests for interpretation or clarification on delegated design professional's instruments of service and other Submittals for the delegated design Work.
  10. Progress and Quality of Construction of Delegated Design Work:
    - a. Where appropriate for the subject delegated design Work, periodically visit the Site at appropriate intervals to observe the progress and quality of the subject delegated design Work.
    - b. Where delegated design professional does not visit the Site during construction, keep informed of the progress and quality of the subject delegated design Work via discussions with Contractor, Subcontractor, and Suppliers, via photographic documentation, and other means acceptable to delegated design professional.
    - c. Advise Contractor in writing when the subject delegated design Work is not in accordance with the delegated design professional's instruments of service (approved by Engineer) and related Submittals approved by delegated design professional.
    - d. Furnish to entity that retained delegated design professional copy of delegated design professional's written report of each visit to the Site.
  11. Modifications to Design:
    - a. Design appropriate modifications to the delegated design Work, including preparing new or revised certifications, reports, design drawings, sketches, design specifications, and calculations, as appropriate.
    - b. Such instruments of service and calculations shall be submitted to Engineer through Contractor to same extent original instruments of service Submittals and calculations, if any, where required by the Contract Documents for the subject delegated design Work.
  12. Other services, as mutually agreed upon by delegated design professional and its client, or as required elsewhere in the Contract Documents.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION - (NOT USED)**

### **END OF SECTION**

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**SECTION 01 42 13**  
**STANDARD ABBREVIATIONS AND SYMBOLS**

**PART 1 - GENERAL**

**1.1 UNITS OF MEASUREMENT**

- A. Units of measurement abbreviations are defined on the drawings.

**1.2 TERMINOLOGY**

- A. Abbreviations associated with terminology are defined in the Drawings, with the following exceptions:
1. Typical equipment abbreviations are listed in 01 61 03 – Equipment: Basic Requirements.
  2. Piping system abbreviations are listed in 40 05 00 – Pipe and Pipe Fittings: Basic Requirements.

**1.3 ORGANIZATIONS AND STANDARDS**

- A. Organizations associated with industry reference standards are defined in each Specification Section.

**END OF SECTION**

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**SECTION 01 45 00**  
**QUALITY ASSURANCE AND CONTROL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Quality assurance and control.
  - 2. Regulatory requirements.
  - 3. Tolerances.
  - 4. Mock-ups.
  - 5. Manufacturer's field services.

**1.2 QUALITY ASSURANCE AND CONTROL**

- A. Monitor quality assurance and control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as minimum quality for Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified and experienced to produce required or specified quality.
- F. Verify that field measurements are as indicated on approved shop drawings or as instructed by manufacturer of product.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- H. Materials shall be compatible with one another and with other materials with which they may come in contact.

**1.3 SUPERVISION AND CONSTRUCTION PROCEDURES**

- A. Contractor shall supervise and direct Work, using Contractor's best skill and attention.
- B. Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of Work under the Contract, unless Contract Documents give other specific instructions concerning these matters.
- C. Whether or not Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall review, substantiate, and comply with current industry execution standards and manufacturer's current execution instructions and evaluate jobsite safety thereof and shall be fully and solely responsible for jobsite safety of such means, methods, techniques, sequences or procedures.
  - 1. If Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to Engineer and shall not proceed with that portion of Work without further written instructions from Engineer.
  - 2. If Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by Contractor, the Engineer shall be solely responsible for any loss or damage arising solely from those Engineer -required means, methods, techniques, sequences or procedures.

- D. Contractor shall be responsible to Engineer for acts and omissions of Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of Work for, or on behalf of Contractor or any of its Subcontractors.
- E. Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.
- F. Contractor is solely responsible for coordination of scope of Work for its own forces, and of Subcontractors and suppliers, and to complete all Work, whether performed by the Contractor or a Subcontractor.
- G. Contractor shall employ Licensed Surveyor to locate and stake out Work and establish necessary reference and benchmarks.
  - 1. Work from established benchmarks and reference points, layout and correctly establish lines, levels, grades, and locations of all parts of their own Work and be responsible for their accuracy and proper correlation with Work and established data.

#### **1.4 REGULATORY REQUIREMENTS**

- A. Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of Work.
- B. If Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction, including, but not limited to, any penalties, fines or other damages realized.
- C. When Contract Documents require Contractor, Subcontractor, Vendor or other supplier to provide selection or design of parts of Work, such selection or design shall meet requirements of Municipal, State or other governmental authorities having jurisdiction.

#### **1.5 TOLERANCES**

- A. Monitor fabrication and installation tolerance control of Products to produce approved Work.
  - 1. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances.
  - 1. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

#### **1.6 MANUFACTURER'S FIELD SERVICES AND REPORTS**

- A. When field services are specified, have material or product suppliers, or manufacturers, provide technically competent staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and supervise installation where specified, as applicable and to initiate instructions when necessary.
- B. Report observations, and site decisions or instructions given to applicators or installers which are supplemental or contrary to manufacturer's written instructions.
- C. Submit report in duplicate within 30 days of observation.

## **PART 2 - PRODUCTS**

Not Used.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available, of correct characteristics, and in correct locations.

### **3.2 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

**END OF SECTION**

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## **SECTION 01 45 25**

### **TESTING CONCRETE STRUCTURES FOR WATERTIGHTNESS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Requirements for furnishing all labor, materials, tools, equipment, and services, for all testing of concrete structures for watertightness, in accord with provisions of the Contract Documents.
  - 2. Completely coordinate with work of all other trades.
  - 3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete leak test.
- B. Related Sections include but are not necessarily limited to, DIV 03:
- C. Payment:
  - 1. Contractor to pay all costs required for testing, test water, retesting, patching, repair and work required to provide access for repair as required to meet watertightness requirements specified or indicated.

##### **1.2 QUALITY ASSURANCE**

- A. Reference Standards:
  - 1. American Concrete Institute (ACI):
    - a. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary.
  - 2. NSF International (NSF).
  - 3. Underwriters Laboratories, Inc. (UL).
  - 4. United States Department of Agriculture (USDA).
  - 5. Water Quality Association (WQA).

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Watertightness testing plan:
    - a. Plan shall include:
      - 1) Schedule for testing.
      - 2) Description of testing apparatus for measuring water level in structure and evaporation pan.
        - a) Include Drawings (plans, sections, and details), sketch, or photos as appropriate to fully describe apparatus.
      - 3) Location plan showing measurement location and evaporation pan location.
      - 4) Procedures for isolation of tank or compartments to assure a constant volume during testing.
      - 5) Narrative describing testing procedure.
      - 6) Calculations showing:
        - a) Total structure volume at water elevation for commencement of test period.
        - b) Maximum water leakage allowed.
        - c) Test period: See ACI 350.1.
      - 7) Plan shall be in accordance with ACI 350.1, Chapters 1 and 2.
  - 2. If structure has running water leaks or otherwise fails watertightness test, submit repair and patching plan. Include with plan:
    - a. Location and areas of leaks.
    - b. Repair material and procedures proposed for repair.

- c. Photographs of all visible leaks and damp areas.
    - 1) Include distant photos and close-ups to document conditions.
- B. Informational Submittals:
  - 1. Results of watertightness testing indicating the following:
    - a. Level of water in structure and in evaporation pan and water temperature at commencement of test period.
    - b. Level of water in structure and in evaporation pan and water temperature at end of test period.
    - c. Net leakage in percent of total volume during test period (gross leakage minus that due to evaporation).
    - d. Results of retesting required due to leakage exceeding specified percentages allowed.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Non-shrink grout: See DIV 03.
  - 2. Epoxy grout: See DIV 03
  - 3. Instant setting waterstop:
    - a. Sikaset Plug by Sika Corporation.
    - b. Sikafix HH LV by Sika Corporation.
    - c. MasterSeal 590 by BASF.
  - 4. Injectable polyurethane sealant:
    - a. De Neef by GCP Applied Technologies, Inc.
    - b. SikaFix HH+ by Sika Corporation.
    - c. Mountain Grout by Green Mountain International.
  - 5. Epoxy adhesive:
    - a. Sikadur-35 Hi-Mod LV by Sika Corporation.
- B. Reference Division 03 specifications for patching and repair materials.

### **2.2 MATERIALS**

- A. Water for Testing:
  - 1. See ACI 350.1.
  - 2. Wastewater plant: Raw or treated effluent water.
  - 3. Water treatment: Potable water.
  - 4. Coordinate delivery of water for testing with Owner.
- A. Reference DIV 03 for patching and repair materials.
- B. Any patching or repair materials that may come into contact with potable water in tanks shall be approved for drinking water per NSF, UL, USDA, or WQA.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION BEFORE TESTING**

- A. General:
  - 1. Verify the specified 28-day concrete strength has been achieved prior to testing.
  - 2. Testing to be performed prior to placement of exterior backfill soil.
    - a. Contractor is responsible for phasing construction to minimize the impact of and to leak testing.
  - 3. Contractor to furnish all necessary materials (such as gaskets and flange cover plates).



4. Testing to be performed prior to application of any specified coatings or insulation or backfilling, unless otherwise noted.
5. Test the following tanks prior to backfilling:
  - a. Clarifier, sludge storage tank, pump station wet well and sumps for drumfilters.
- A. Source of water:
  1. Coordinate use and delivery of test water test with Owner.
  2. The source of water will be hatchery effluent water].
  3. Contractor shall provide the means of transporting the water to the structure being tested.
- B. Cleaning:
  1. Thoroughly clean interior of structure to be tested of all debris and dirt and hose down surfaces of all walls and slabs.
  2. Cleaning may be required after satisfactory test completion.
- C. Patching and Finishing:
  1. Prepare concrete surfaces in accordance with ACI 350.1 and DIV 03.
    - a. Fill all holes, voids, and honeycombed areas per DIV 03. Cracks suspected to cause leakage to be filled and sealed.
    - b. Review tank for areas of potential leakage before filling.

### **3.2 WATERTIGHTNESS TESTING**

Commence testing with water 12" from structure rim unless specified otherwise in the Drawings or other Sections.

- A. Perform a watertightness test as required by Engineer on any additional structure when in the opinion of the Engineer the structure contains sufficient concrete defects that could impair the watertightness of the structure.
  1. Testing to conform to requirements of this Section with allowable leakage and other criteria as established by Engineer.
- B. Test for leakage in accordance with ACI 350.1, latest edition, Chapters 1 and 2, and this Section.
  1. Isolate sections of structures that can be isolated during operation.
    - a. Test each section separately.
  2. Allow Owner's Representative to witness testing for watertightness and review accompanying results.
- C. Place evaporation pan in an easily accessible location.
- D. Record level of water in structure and evaporation pan and water temperature at commencement of the test period.
- E. During testing period, inspect structure for areas indicating leakage.
  1. Any areas evidencing running water to be repaired and patched.
  2. Patching or repair of leaks as defined above shall be completed independent of the watertightness test.
    - a. Passing watertightness test does not relieve Contractor from repairing running water leaks.
- F. Record level of water surface in the structure and evaporation pan and temperature every 24 HRS until end of test period.
  1. Test periods defined per ACI 350.1.
- G. If leakage is greater than that allowed, repair and patch areas suspected of causing the leakage.
  1. Re-test structure using the same procedure until leakage is equal to or less than that allowed.
  2. Provide repair plan to Engineer for approval prior to repair of tank.
  3. Cracks suspected to cause leakage to be filled and sealed to prevent leakage.
    - a. Patching to be performed after defective concrete area is cleaned of all loose material to surface of sound concrete.

4. Prior to patching activities, Contractor to submit patching materials and procedures for review and approval by Engineer.
- H. Dispose of water used for testing.
1. Dispose of water used for testing to an area which will not damage new or existing construction and will not interfere with construction operations or plant operations.
  2. Provide hoses, temporary connections, temporary fittings and other conduits as necessary to dispose of test water without damage to structure or terrain.
  3. Point of disposal to be approved by Owner.

**END OF SECTION**

**SECTION 01 45 33**  
**SPECIAL INSPECTIONS AND TESTING PROGRAM**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Contractor responsibilities for special inspection and testing.
  - 2. Special Inspection program and reporting requirements.
  - 3. Attachment A to this Specification Section includes the Submittal of Special Inspections.
- B. Purpose:
  - 1. This Document was developed to address the requirements of the 2015 Maine Uniform Statewide Building Code, including:
    - a. One or more special inspectors will be hired by contractor (approved by owner) to provide inspections during constructions on the types of work listed under Section 1704.
  - 2. A Statement of Special Inspections will be submitted to the Building Code Official as a condition for permit issuance. This statement is included as Attachment A to this Specification. Attachment B includes a complete list of materials and work requiring special inspections, the inspections to be performed and a list of the minimum qualifications of the individuals, approved agencies or firms intended to be retained for conducting such inspections.
- C. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.

**1.2 DEFINITIONS**

- A. Special Inspector: Representative of the Owner approved inspection agency designated for that portion of the work.
- B. Testing Agency: Approved agency, not affiliated by the Contractor, which is responsible for the materials testing requirements of the project including but not limited to concrete cylinder breaks, soils testing, and masonry materials testing.
- C. Statement of Special Inspections: Document provided to the Building Code Official outlining special inspections and tests to be done on the project and frequency of required test.
- D. Soils Engineer or Geotechnical Engineer: For the purposes of Special Inspection "Soils Engineer," "Geotechnical Engineering," and "Special Inspector" shall be interchangeable as pertains to the Division 31 specifications.
- E. NICET: National Institute for Certification in Engineering Technologies.

**1.3 CONTRACTOR'S RESPONSIBILITIES**

- A. Cooperate with testing agency personnel, special inspector, and agents of the Building Code Official and provide access to the work.
  - 1. Providing access to the work shall include all labor and facilities to perform inspections and tests as listed in the specifications for the duration of the inspections or tests involved.
  - 2. Provide means to obtain and handle samples taken on site.
- B. Attend a pre-construction meeting to coordinate and clarify inspection and testing procedures, requirements.
- C. Notify special inspector and/or testing agency of work to be inspected/tested minimum of 24 HRS prior.

- D. Work for which special inspections are required shall remain accessible and exposed for the purposes of special inspections until completion of required special inspections.
- E. Any portion of work that is not in conformance shall be corrected and re-inspected. Such portions of the work shall not be covered or concealed until authorized by the Owner.
- F. Work to be inspected should be complete at time of inspector's arrival on-site.
- G. Payment for Special Inspection services will be in accordance with the following:
  - 1. Payment described below is for the Testing Agency and Special Inspector costs and does not include the Contractor's costs listed in Paragraph 1.3 A.
  - 2. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
    - a. Inspection reveals work is satisfactory.
    - b. Owner pays all costs associated with this inspection.
  - 3. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
    - a. Inspection reveals work is deficient.
    - b. Contractor corrects deficiencies within timeframe defined in Item 4) below.
    - c. Work is re-inspected and work is satisfactory.
    - d. Owner pays all costs associated with this inspection.
  - 4. After Contractor notification, inspector arrives at site and work is not ready for inspection when inspector arrives.
    - a. Inspector will remain on-site for a maximum of 2 HRS awaiting the completion of the work.
    - b. If work is not ready for inspection at the end of this period, inspector will be dismissed until Contractor requests re-inspection.
    - c. All costs associated with this inspection trip will be charged to the Contractor.
  - 5. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 above.
    - a. Inspection reveals work is deficient.
    - b. Contractor attempts to correct deficiencies within 2 HR timeframe and calls for re-inspection.
    - c. Work is re-inspected and found to still be deficient.
    - d. Inspector will be dismissed.
    - e. All costs associated with this inspection trip will be charged to the Contractor.
  - 6. Owner will pay for "passing" soils on the Project. Costs of corrective actions and cost of failed test areas requiring retesting are the sole responsibility of the Contractor. For additional specific payment requirements for soils see the respective Division 31 Section.
- H. Special Inspection is intended to be an independent quality assurance. Special Inspections shall not relieve the Contractor of any quality assurance, quality control, workmanship, or warranty responsibilities. Contractor's own personnel shall review all work to be inspected for conformance with Contract Documents prior to calling for inspection.

#### **1.4 REPORTING DUTIES AND AUTHORITY**

- A. A pre-construction meeting to coordinate and clarify inspection, testing, and procedural requirements will be held per Section 00 72 13.
  - 1. The meeting is to be attended by:
    - a. Owner.
    - b. Engineer.
    - c. Building Code Official or designee.
    - d. Testing Agency and Special Inspectors.
    - e. General Contractor.
    - f. Appropriate Sub-contractor(s).
- B. Special Inspector shall report all deficient work to the Contractor as soon as possible.

1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Owner and the Building Code Official.
- C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**END OF SECTION**

**ATTACHMENT A TO SECTION 01 45 33**  
**SPECIAL INSPECTIONS, INSPECTOR QUALIFICATIONS AND REPORTING**  
**REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
  2. Division 01 - General Requirements.
  3. Section 03 05 05 - Concrete Testing and Inspection.
  4. Section 04 22 00 - Concrete Masonry.
  5. Section 05 50 00 - Metal Fabrications.
  6. Section 31 23 00 - Earthwork.

**1.2 QUALIFICATIONS**

- A. Qualifications stated here are the minimum recommended by the Engineer. If the Building Code Official has more stringent qualifications, the more stringent qualifications will take precedence.
- B. All Special Inspections and Testing to be done under the direction of a Professional Engineer or Registered Architect registered in the State of Maine herein referred to as Registered Professional for Special Inspections (RPSI).
- C. Soil, concrete, masonry, mortar, grout, steel and aluminum related testing.
1. The Testing Agency shall have a minimum of 10 year's experience in the testing of these materials.
  2. The Testing Agency's technician(s) conducting this testing:
    - a. Shall have a minimum of five (5) year's experience in the testing of soil, concrete, mortar, grout, steel and aluminum as appropriate.
  3. Concrete related work:
    - a. International Code Council certification for Reinforced Concrete and American Concrete Institute Concrete Field Testing Technician – Grade 1.
- D. Special Structural Inspections:
1. Professional Engineers or Architects, licensed in the State of Maine, may perform special inspections in accordance with their license qualifications.
  2. Other individuals, working under the direct supervision of a licensed engineer and meeting the following qualifications, may perform special inspections.
  3. Soils related work:
    - a. NICET Level II Certification in geotechnical engineering technology/construction; or
    - b. Registered Geologist; or
    - c. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
  4. Concrete related work:
    - a. International Code Council certification for Reinforced Concrete Special Inspector or American Concrete Institute Concrete Construction Special Inspector.
    - b. Alternatively, may be an Engineer Intern under the direct supervision of a Licensed Professional Engineer.
  5. Precast concrete erection related work:
    - a. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
  6. Precast concrete erection welding:
    - 1) American Welding Society as a Certified Welding Inspector; or
    - 2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one (1) year of related experience; or
    - 3) NDT Level II or II Certificate (for non-destructive testing only).

7. Masonry related work:
  - a. Shall be certified by the International Code Council or American Concrete Institute for structural masonry and one (1) year of related experience.
  - b. Alternatively, may be an Engineer Intern with a minimum of two (2) years appropriate training.
8. Steel and aluminum related work:
  - a. Frame and material verification IBC Table 1704.3, Items 3 and 6:
    - 1)
  - b. Welding:
    - 1) American Welding Society as a Certified Welding Inspector; or
    - 2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one (1) year of related experience; or
    - 3) NDT Level II or II Certificate (for non-destructive testing only).
  - c. High strength bolting:
    - 1) International Code Council Structural Steel and Welding Certification and one (1) year related experience.
    - 2) Alternatively, may be an Engineer Intern with appropriate training.
9. Fire resistive coating (intumescent paint) related work:
  - a. International Code Council Spray-Applied Fireproofing Certification and (3) years of related experience; or
  - b. International Code Council Fire Inspector 1 Certification and (3) years of related experience.
10. Other equivalent certifications will not be acceptable unless approved by the Engineer.

### **1.3 REPORTING DUTIES AND AUTHORITY**

- A. Reporting requirements for special inspector per IBC 2009 for Building System Related Work.
  1. Comply with requirements of IBC Section 1704.1.2.
  2. Provide written documentation of all inspections and testing.
    - a. Include exact location of work.
    - b. If testing of specimens is included, include detailed information on storage and curing of specimens prior to testing.
  3. Furnish inspection and test reports to the Contractor, the Engineer's Project Manager .
    - a. Indicate that work inspected was done in conformance with approved construction documents.
    - b. Immediately report any discrepancies to the Contractor for correction.
    - c. If the discrepancies are not corrected in a timely fashion, notify the Engineer's Project Manager.
  4. Issue an electronic report summarizing all inspections, corrective action notifications and resolution of discrepancies and non-conforming work every two (2) weeks (14 calendar days).
    - a. Copy will be available to:
      - 1) Engineer's Project Manager.
      - 2) The Building Code Official.
      - 3) General Contractor.
  5. At the end of the Project, the RPSI shall compile all test reports for each inspected material and for each Special Inspector and summarize into a single PDF and submit to the Owner and Building Code Official.
    - a. Final summary report to be signed and sealed by a Registered Professional for Special Inspections stating:
      - 1) The required Special Inspections have been performed.
      - 2) All discrepancies have been resolved except as specifically stated in the summary report.

- B. Special Inspector shall report all deficient work to the Contractor as soon as possible.
  - 1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.
- C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

#### **1.4 MATERIAL SPECIFIC SPECIAL INSPECTIONS AND TESTS**

- A. Material specific requirements for special inspection and testing are listed in the technical specifications listed below. Special inspection and testing requirements will be located in each appropriate technical specification under "SOURCE QUALITY CONTROL", "FIELD QUALITY CONTROL" and/or "QUALITY ASSURANCE" as appropriate for each material.

#### **1.5 SOILS**

- A. Special Inspection/testing will be provided per IBC Section 1704.7 and Table 1704.7 as required to determine that the site has been prepared in accordance with the approved soils report, and to verify the allowable soil bearing pressure, materials, compaction densities, trenching and backfill and conformance to the project Specifications.
- B. Inspection/testing requirements are listed separately in Specification Division 31 and are indicated as the work to be done by the Geotechnical Engineer, Testing Agency, or Special Inspections and Testing Provider.

#### **1.6 CONCRETE**

- A. Special Inspection and testing will be provided per IBC Table 1704.4. Inspection is required for material verification, reinforcing steel, embedded bolts, mechanical splices, concrete tests, welding of reinforcing, concrete placement and curing, and waterstop placement.
- B. Inspection and testing requirements are listed separately in Specification Section 03 05 05 and are indicated as the work to be done by the Special Inspector or Testing Agency.

#### **1.7 MASONRY**

- A. Special Inspection and testing will be provided per IBC Table 1704.5.3 (Level 1). Inspection is required for material tests and verification, reinforcing steel, embedded bolts and anchorage, grout placement, and welding of reinforcing.

#### **1.8 STEEL, STAINLESS STEEL, AND ALUMINUM**

- A. Special Inspection will be provided for structural steel and aluminum per IBC Section 1704.2, 1704.3 and Table 1704.3. Inspection is required for material verification, high-strength bolting, welding and other work noted on the Contract Documents.
- B. Inspection/testing requirements are listed separately in Section 05 50 00 and are indicated as the work to be done by the Special Inspector. Inspection requirements listed are applicable to aluminum, stainless steel, and structural steel.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS ATTACHMENT)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS ATTACHMENT)**

### **END OF ATTACHMENT A**



**SECTION 01 61 03**  
**EQUIPMENT - BASIC REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Requirements of this Specification Section apply to all equipment provided on the Project including those found in other Divisions even if not specifically referenced in individual "Equipment" Articles of those Specification Sections.
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 03 15 19 - Anchorage to Concrete
  - 3. Section 03 31 30 - Concrete, Materials and Proportioning.
  - 4. Section 05 50 00 - Metal Fabrications.
  - 5. Section 07 92 00 - Joint Sealants.
  - 6. Section 09 96 00 - High Performance Industrial Coatings.
  - 7. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Bearing Manufacturers Association (ABMA).
  - 2. American Gear Manufacturers Association (AGMA).
  - 3. ASTM International (ASTM):
    - a. E1934, Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography.
    - b. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - 4. Hydraulic Institute (HI):
    - a. 9.6.4, Centrifugal and Vertical Pumps for Vibration Measurements and Allowable Valves.
  - 5. International Electrotechnical Commission (IEC).
  - 6. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
  - 7. International Organization for Standardization (ISO):
    - a. 1940, Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances.
    - b. 21940-11, Mechanical Vibration - Rotor Balancing - Part 11: Procedures and Tolerances for Rotors with Rigid Behavior.
  - 8. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. ICS 6, Enclosures for Industrial Control and System.
    - c. MG 1, Motors and Generators.
  - 9. InterNational Electrical Testing Association (NETA):
    - a. ATS, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
  - 10. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC):
  - 11. National Institute for Certification in Engineering Technologies (NICET).
  - 12. National Institute of Standards and Technology (NIST).
  - 13. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
  - 14. Underwriters Laboratories, Inc. (UL).

- a. 508, Standard for Safety Industrial Control Equipment.
  - b. 508A, Standard for Safety Industrial Control Panels.
  - c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
- B. Miscellaneous:
  - 1. A single manufacturer of a "product" shall be selected and utilized uniformly throughout Project even if:
    - a. More than one (1) manufacturer is listed for a given "product" in Specifications.
    - b. No manufacturer is listed.
  - 2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall fully comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS 6 designations.
  - 3. Variable speed equipment applications: The driven equipment manufacturer shall have single source responsibility for coordination of the equipment and VFD system and verify their compatibility.

### 1.3 DEFINITIONS

- A. Product: Manufactured materials and equipment.
- B. Major Equipment Supports - Supports for Equipment:
  - 1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS or greater, or;
  - 2. Located on or suspended from roofs with supported equipment weighing 500 LBS or greater, or;
  - 3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.
- C. Equipment:
  - 1. One (1) or more assemblies capable of performing a complete function.
  - 2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection.
  - 3. Not limited to items specifically referenced in "Equipment" articles within individual Specifications.
- D. Installer or Applicator:
  - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  - 2. Installer and applicator are synonymous.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  - 1. General for all equipment:
    - a. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
    - b. Data sheets that include manufacturer's name and complete product model number.
      - 1) Clearly identify all optional accessories that are included.
    - c. Acknowledgement that products submitted comply with the requirements of the standards referenced.
    - d. Manufacturer's delivery, storage, handling, and installation instructions.
    - e. Equipment identification utilizing numbering system and name utilized in Drawings.
    - f. Equipment installation details:
      - 1) Location of anchorage.
      - 2) Type, size, and materials of construction of anchorage.
      - 3) Anchorage setting templates.
      - 4) Manufacturer's installation instructions.
    - g. Equipment area classification rating.
    - h. Shipping and operating weight.

- i. Equipment physical characteristics:
  - 1) Dimensions (both horizontal and vertical).
  - 2) Materials of construction and construction details.
- j. Equipment factory primer and paint data.
- k. Manufacturer's recommended spare parts list.
- l. Equipment lining and coatings.
- m. Equipment utility requirements include air, natural gas, electricity, and water.
- n. Ladders and platforms provided with equipment:
  - 1) Certification that all components comply fully with OSHA requirements.
  - 2) Full details of construction/fabrication.
  - 3) Scaled plan and sections showing relationship to equipment.
- 2. Mechanical and process equipment:
  - a. Operating characteristics:
    - 1) Technical information including applicable performance curves showing specified equipment capacity, range ability, and efficiencies.
    - 2) Brake horsepower requirements.
    - 3) Copies of equipment data plates.
  - b. Piping and duct connection size, type and location.
  - c. Equipment bearing life certification.
  - d. Equipment foundation data:
    - 1) Equipment center of gravity.
    - 2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
- 3. Electric motor:
  - a. Motor manufacturer and model number.
  - b. Complete motor nameplate data.
  - c. Weight.
  - d. NEMA design type.
  - e. Enclosure type.
  - f. Frame size.
  - g. Winding insulation class and temperature rise.
  - h. Starts per hour.
  - i. Bearing data and lubrication system.
  - j. Natural frequency calculations for:
    - 1) Completed assembly including but not limited to the equipment base, rotating piece of equipment, and the rotating piece of equipment driver.
    - 2) Individual piece of rotating equipment.
    - 3) Equipment driver and connected gear reducer, if applicable.
  - k. Thermal protection system including recommended alarm and trip settings for winding and bearing RTD's.
  - l. Fabrication and/or layout drawings:
    - 1) Dimensioned outlined drawing.
    - 2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).
  - m. Certifications:
    - 1) When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
    - 2) When utilized with a variable frequency controller, certify motor is inverter duty and the controller and motor are compatible.
      - a) Include minimum speed at which the motor may be operated for the driven machinery.
  - n. Electrical gear:
    - 1) Unless specified in a narrow-scope Specification Section, provide the following:
      - a) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.
    - 2) Control panels:

- a) Panel construction.
    - b) Point-to-point ladder diagrams.
    - c) Scaled panel face and subpanel layout.
    - d) Technical product data on panel components.
    - e) Panel and subpanel dimensions and weights.
    - f) Panel access openings.
    - g) Nameplate schedule.
    - h) Panel anchorage.
    - i) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70.  
Include any required calculations.
  - 4. Systems schematics and data:
    - a. Provide system schematics where required in system specifications.
      - 1) Acknowledge all system components being supplied as part of the system.
      - 2) Utilize equipment, instrument and valving tag numbers defined in the Contract Documents for all components.
      - 3) Provide technical data for each system component showing compliance with the Contract Document requirements.
      - 4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.
  - 5. For factory painted equipment, provide paint submittals in accordance with Section 09 96 00.
- B. Contract Closeout Information:
- 1. Operation and Maintenance Data:
    - a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Motors:
    - a. Baldor.
    - b. General Electric.
    - c. Hyundai Heavy Industries.
    - d. Marathon Electric.
    - e. Rockwell - Reliance.
    - f. Siemens.
    - g. TECO-Westinghouse.
    - h. Toshiba U.S.
    - i. U.S. Motors, Nidec Motor Corporation.
    - j. WEG.
- B. Submit request for substitution in accordance with Section 01 25 13.

### **2.2 MANUFACTURED UNITS**

- A. Electric Motors:
  - 1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
  - 2. Design for frequent starting duty equivalent to duty service required by driven equipment.
  - 3. Design for full voltage starting.
  - 4. Design bearing life based upon actual operating load conditions imposed by driven equipment.
  - 5. Size for altitude of Project.

6. Furnish with stainless steel nameplates which include all data required by NEC Article 430.
  7. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.
  8. AC electric motors less than 1/3 HP:
    - a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Permanently lubricated sealed bearings conforming to ABMA standards.
    - c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
  9. AC electric motors 1/3 to 1 HP:
    - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Permanently lubricated sealed bearings conforming to ABMA standards.
      - 1) For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
  10. AC electric motors 1-1/2 to 10 HP:
    - a. 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Permanently lubricated sealed bearings conforming to ABMA standards.
    - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
  11. AC electric motors greater than 10 HP:
    - a. 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
      - 1) Design bearing life for 90 PCT survival rating at 50,000 HRS of operation for motors up to and including 100 HP.
      - 2) For motors greater than 100 HP, design bearing life for 90 PCT survival rating at 100,000 HRS of operation.
    - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
  12. Severe duty motor to have the following minimum features:
    - a. All cast iron construction.
    - b. Gasketed conduit box.
    - c. Epoxy finish for corrosion protection.
    - d. Hydrosopic varnish on windings for corrosion protection.
    - e. Drain plug and breather.
- B. NEMA Design Squirrel Cage Induction Motors:
1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
  2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
  3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
  4. For use on variable frequency type adjustable speed drives, provide:
    - a. Induction motors that are in compliance with NEMA MG 1, Part 31.
    - b. Nameplate identification meeting NEMA MG 1 Part 31 requirements.
    - c. Insulated drive end bearing on all motors.
    - d. Insulated non-drive end bearings, at a minimum, on all motors with horizontal shaft 100 HP and larger.
    - e. An insulated bearing carrier on the non-drive end for vertical shaft motors 100 HP and larger.
    - f. Shaft grounding ring on all motors:
      - 1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
      - 2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.

- g. Have the following minimum turndown ratio without the use of additional cooling, such as a blower, to provide continuous supply of cooling air over the motor.
  - 1) Variable torque: 10:1.
  - 2) Constant torque: 6:1.
- 5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 DEGC ambient.
- 6. Design motors for continuous duty.
- 7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 PCT greater than the maximum HP requirements of the driven equipment over its entire operating range.
  - a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
- 8. Motor enclosure and winding insulation application:
  - a. The following shall apply unless modified by specific Specification Sections:

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Unclassified Indoor Areas	DPFG (for horizontal motors), WP-I (for vertical motors)
Wet indoor Areas	TEFC, Encapsulated Windings, and WP-II (for vertical motors)
Wet outdoor Areas	Encapsulated Windings, and WP-II (for vertical motors)
Corrosive Areas	TEFC, Severe/ Chemical Duty
Class I, Division 1 Areas	Explosion Proof, Approved for Class I Division 1 Locations
Class II, Division 1 Areas	Explosion Proof, Approved for Class II Division 1 Locations
Class I or Class II, Division 2 Areas	Explosion Proof, Approved for Division 1 Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area.

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

- 9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.
- 10. Balance motors to ISO G2.5 level.
- C. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.
- D. V-Belt Drive:
  - 1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
  - 2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
  - 3. Provide staticproof belts.
- E. Vibration Isolators:
  - 1. Provide all equipment subject to vibration with restrained spring type vibration isolators or pads according to the manufacturer's written recommendation.
- F. Space Heaters:
  - 1. Silicone rubber strip type, 120 V rated.
  - 2. Provided on:
    - a. All motors 10 HP and larger mounted outdoors.
    - b. Indoor motors in humid environments as indicated.

## 2.3 COMPONENTS

- A. Gear Drives and Drive Components:
  - 1. Size drive equipment capable of supporting full load including losses in speed reducers and power transmission.

2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to nameplate horsepower of drive motor.
3. Design drive units for 24 HR continuous service, constructed so oil leakage around shafts is precluded.
4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and flexible couplings meeting applicable standards of AGMA.
5. Gear reducers:
  - a. Provide gear reducer totally enclosed and oil lubricated.
  - b. Utilize antifriction bearings throughout.
  - c. Provide worm gear reducers having a service factor of at least 1.20.
  - d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1.50.

## 2.4 ACCESSORIES

### A. Guards:

1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
2. Interior applications:
  - a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
  - b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
  - c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
3. Exterior applications:
  - a. Construct from 16 GA stainless steel or aluminum.
  - b. Construct to preclude entrance of rain, snow, or moisture.
  - c. Roll to conform to shaft or coupling surface.
  - d. Connect to equipment frame with stainless steel bolts and wing nuts.

### B. Anchorage:

1. Cast-in-place anchorage:
  - a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
  - b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
  - c. Provide two (2) nuts for each bolt.
2. Drilled anchorage:
  - a. Adhesive anchors per Section 05 50 00.
  - b. Epoxy grout per Section 03 31 30.
  - c. Threaded rods same as cast-in-place.

### C. Data Plate:

1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

### D. Gages:

1. Provide gages as shown on the drawings.
2. Provide at the following locations:
  - a. Inlet and outlet of all reciprocating, centrifugal and positive displacement mechanical and process equipment.
  - b. At locations identified on Drawings.
3. Utilize tapping sleeves for mounting per Section 40 05 00.

### E. Lifting Eye Bolts or Lugs:

1. Provide on all equipment 50 LBS or greater.
2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.

- F. Platforms and Ladders:
  - 1. Design and fabricate in accordance with OSHA Standards.
  - 2. Fabricate components from galvanized steel or fiberglass-reinforced plastic.
  - 3. Provide platform surface: Non-skid grating, unless specified in narrow-scope Specification Sections.

## 2.5 FABRICATION

- A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.
- B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.
- C. Furnish like parts of duplicate units to be interchangeable.
- D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.
- E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
  - 1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.
- F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
  - 1. Provide drain connection for 3/4 IN PVC tubing.
- G. Machine the mounting feet of rotating equipment.
- H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that cannot be properly prepared and painted.
  - 1. When such back to back fabrication cannot be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
  - 2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Section 07 92 00.
- I. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
  - 1. Manufacturer's standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
  - 2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
  - 3. Affix entire assembly with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to delivery.
    - a. Control panels without an affixed UL 508A or UL 698A label shall be rejected.
  - 4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
    - a. Determine the SCCR rating by one of the following methods:
      - 1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
      - 2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
      - 3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
    - b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
    - c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.



## **2.6 SHOP OR FACTORY PAINT FINISHES**

## **2.7 SOURCE QUALITY CONTROL**

### **A. Motor Tests:**

1. Test motors in accordance with NEMA and IEEE standards.
2. Provide routine test for all motors.
3. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.
  - a. Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
  - b. The Contractor will pay all costs, including shipping and handling, for all motors failing the tests.
  - c. If two (2) successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.
- B. Utilize templates for anchorage placement for slab-mounted equipment.
- C. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain.
  1. Route clear of major traffic areas and as approved by Engineer.
- D. DO NOT construct foundations until major equipment supports are approved.
- E. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings from closest operating floor level.
- F. Equipment Base:
  1. Construct level in both directions.
  2. Take particular care at anchor bolt locations so these areas are flat and level.
- G. Machine Base:
  1. Mount machine base of rotating equipment on equipment base.
    - a. Level in both directions, using a machinist level, according to machined surfaces on base.
  2. Level machine base on equipment base and align couplings between driver and driven unit using stainless steel blocks and shims.
    - a. Blocks and shims milled flat and coplanar of both faces.
    - b. Maximum of 3 shims under each foot.
    - c. Size blocks and shims to provide solid support at each mounting bolt location.
      - 1) Provide area size of blocks and shims approximately 1-1/2 times area support surface at each mounting bolt point.
    - d. Provide blocks and shims at each mounting bolt.
      - 1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on mounting bolts.
    - e. After all leveling and alignment has been completed and before grouting, tighten mounting bolts to proper torque value.
- H. Rotating equipment Couplings:
  1. Align in the annular and parallel positions.
    - a. For equipment rotating at 1200 RPM or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller.

- b. Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
    - c. For equipment rotating at speeds greater than 1200 RPM allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
  - 2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
  - 3. Check surfaces for runout before attempting to trim or align units.
- I. Grouting:
  - 1. After machine base has been shimmed, leveled onto equipment base, couplings aligned and mounting bolts tightened to correct torque value, place a dam or formwork around base to contain grouting between equipment base and equipment support pad.
    - a. Extend dam or formwork to cover leveling shims and blocks.
    - b. Do not use nuts below the machine base to level the unit.
  - 2. Saturate top of roughened concrete subbase with water before grouting.
    - a. Add grout until entire space under machine base is filled to the top of the base underside.
    - b. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.
  - 3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface.
    - a. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout.
    - b. When the grout has fully hardened (after a minimum of seven (7) days) tighten all anchor bolts to engage equipment base to grout, shims, and equipment support pad.
    - c. Recheck driver-driven unit for proper alignment.

### **3.2 INSTALLATION CHECKS**

- A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
  - 1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.
- B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
  - 1. Has been properly installed and lubricated.
  - 2. Is in accurate alignment.
  - 3. Is free from any undue stress imposed by connecting piping or anchor bolts.
  - 4. Has been operated under full load conditions and that it operated satisfactorily.
    - a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.
- C. No separate payment shall be made for installation checks.
  - 1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

### **3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS**

- A. Identify equipment and install hazard warning signs as needed.

### **3.4 WIRING CONNECTIONS AND TERMINATION**

- A. Clean wires before installing lugs and connectors.
- B. Coat connection with oxidation eliminating compound for aluminum wire.
- C. Terminate motor circuit conductors with copper lugs bolted to motor leads.
- D. Tape stripped ends of conductors and associated connectors with electrical tape.

1. Wrapping thickness shall be 150 PCT of the conductor insulation thickness.
- E. Connections to carry full ampacity of conductors without temperature rise.
- F. Terminate spare conductors with electrical tape.

### **3.5 FIELD QUALITY CONTROL**

- A. General:
  1. Furnish equipment manufacturer's field quality control services and testing as specified in the individual equipment Specification Sections.
  2. Execute pre-demonstration requirements in accordance with Section 01 75 00.
  3. Perform and report on all tests required by the equipment manufacturer's Operation and Maintenance Manual.
  4. Provide testing of electrical equipment and connections in accordance with the Electrical specifications.
  5. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
    - a. Contract Drawings and Specifications.
    - b. Related construction change documentation.
    - c. Approved Shop Drawings.
    - d. Approved Operation and Maintenance Manuals.
    - e. Other pertinent information as required.
- B. Electrical Equipment and Connections Testing Program:
  1. Perform testing on Electrical equipment and connections in accordance with the Electrical specification requirements.
  2. Testing of motors:
    - a. After installation and prior to energizing the motor, perform inspections and tests per NETA ATS 7.15 for all motors 20 HP or above.
    - b. Ensure motor has been lubricated.
    - c. Bump motor to check for correct rotation.
  3. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.
- C. Other Testing:
  1. Perform tests and inspections not specifically listed but required to assure equipment is safe to energize and operate.
  2. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs, and cross members that are cast, welded, or bolted shall be tested for a natural frequency of vibration after equipment is mounted.
    - a. The ratio of the natural frequency of the structure to the frequency of the disturbing force shall not be between 0.5 and 1.5.

### **3.6 DEMONSTRATION**

- A. Demonstrate equipment in accordance with Section 01 75 00.

## **END OF SECTION**

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**SECTION 01 65 50**  
**PRODUCT DELIVERY, STORAGE, AND HANDLING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Scheduling of product delivery.
  - 2. Packaging of products for delivery.
  - 3. Protection of products against damage from:
    - a. Handling.
    - b. Exposure to elements or harsh environments.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
- C. Payment:
  - 1. No payment will be made to Contractor for equipment or materials not properly stored and insured or without approved Shop Drawings.
    - a. Previous payments for items will be deducted from subsequent progress estimate(s) if proper storage procedures are not observed.

**1.2 DELIVERY**

- A. Scheduling: Schedule delivery of products or equipment as required to allow timely installation and to avoid prolonged storage.
- B. Packaging: Deliver products or equipment in manufacturer's original unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.
- C. Identification: Clearly and fully mark and identify as to manufacturer, item, and installation location.
- D. Protection and Handling: Provide manufacturer's instructions for storage and handling.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION**

**3.1 PROTECTION, STORAGE AND HANDLING**

- A. Manufacturer's Instruction:
  - 1. Protect all products or equipment in accordance with manufacturer's written directions.
    - a. Store products or equipment in location to avoid physical damage to items while in storage.
    - b. Handle products or equipment in accordance with manufacturer's recommendations and instructions.
  - 2. Protect equipment from exposure to elements and keep thoroughly dry.
  - 3. When space heaters are provided in equipment, connect and operate heaters during storage until equipment is placed in service.

**3.2 STORAGE FACILITIES**

- A. Provide temporary storage as required to store all materials per manufacturer's recommendations.

1. Provide a weatherproof temporary storage specifically for the purpose of providing for protection of products and equipment.
  - a. Size storage to accommodate anticipated storage items
2. Equip storage with lockable doors and lighting, and provide electrical service for equipment space heaters and heating or ventilation as necessary to provide storage environments acceptable to specified manufacturers.
3. Provide methods of storage of products and equipment off the ground.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect Deliveries:
  1. Inspect all products or equipment delivered to the site prior to unloading.
    - a. Reject all products or equipment that are damaged, used, or in any other way unsatisfactory for use on Project.
- B. Monitor Storage Area: Monitor storage area to ensure suitable temperature and moisture conditions are maintained as required by manufacturer or as appropriate for particular items.

### **END OF SECTION**

**SECTION 01 71 14**  
**MOBILIZATION AND DEMOBILIZATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Project mobilization and demobilization.
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.

**1.2 GENERAL**

- A. Mobilization work shall consist of preparatory work and operations necessary to be ready to perform the Work required under the Contract, and for other work and operations which must be performed, or costs incurred prior to the beginning of the Work.
- B. Demobilization work shall consist of all activities and costs for transportation of personnel, equipment, and supplies necessary to demobilize the contractor from the site.
- C. Mobilization and Demobilization shall not include mobilization or demobilization for specific items of work for which payment is provided elsewhere in the Contract.
- D. When the Contract or proposed Schedule of Values includes a separate item for mobilization or demobilization, payment will include full compensation for the furnishings of all labor, materials, tools, equipment, administrative costs, and incidentals to mobilization or demobilization.
- E. If additional mobilization and demobilization activities and costs are required during the performance of the Contract as a result of the changed, deleted, or added items of work for which the Contractor is entitled to an adjustment in Contract price, compensation for such costs shall be included in the price adjustment for the item of Work changed or added.

**1.3 ITEMS INCLUDED**

- A. Mobilization costs shall be limited to the following items:
  - 1. Obtaining required permits and licenses.
  - 2. Developing Project Work Schedule.
  - 3. Attending Preconstruction Conference.
  - 4. Processing Permits.
  - 5. Furnishing and installing signs.
  - 6. Any work that is necessary to provide access to the site, including, but not limited to, grading and clearing.
  - 7. Installing temporary construction power wiring.
  - 8. Necessary assembly and testing required prior to start of the Work.
  - 9. Establishment of all and other facilities necessary for the Work, including utilities and specified field offices.
  - 10. Providing for and establishing Contractor's work and storage yard.
  - 11. Movement of personnel, major equipment, supplies, and incidentals to the site.
  - 12. Cost incurred prior to the start of the Work which must be performed, such as a down payment on a long lead item.
- B. Demobilization costs shall be limited to the following items:
  - 1. Disassembly, removal and site cleanup/repair of offices, buildings, and other facilities assembled on the site for the Contract.

2. Costs for final site cleanup, packaging of miscellaneous items for return to the yard and other project closeout related expenses.
  3. Cost for final payment documents, and provision of Acknowledgement Certification Request, Bond, and Certificate of Completion.
- C. Owner will pay all costs for the Mobilization and Demobilization of all of the Contractor's personnel, equipment, supplies, and incidentals at the contract lump sum price as follows:
1. Owner will pay no greater than 5 PCT of the original Contract Amount as a separate pay item for mobilization.
  2. Owner will pay no greater than 1/2 PCT of the original Contract Amount as a separate pay item for demobilization.
  3. Owner will pay 50 PCT of the Mobilization lump sum price when 5 PCT of the original Contract Amount is earned.
  4. Owner will pay the remaining 50 PCT of the Mobilization lump sum price when 10 PCT of the original Contract Amount is earned.
  5. Owner will pay 100 PCT of the Demobilization lump sum price when all closeout activities and documents are completed.
  6. Furnish cost data and documentation to justify this portion of the bid if Owner believes that the percentages in this paragraph do not bear a reasonable relation to the cost of the work in this contract.
  7. Failure to justify such price to the satisfaction of the Owner will result in payment as determined by the Owner, of:
    - a. Actual mobilization costs at completion of mobilization.
    - b. Actual demobilization costs at completion of demobilization; and.
    - c. The remainder of this item in the final payment under this contract.
  8. The Owner's determination of the actual costs in this paragraph is not subject to appeal.
  9. This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the Contract.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**END OF SECTION**



## **SECTION 01 71 23**

### **FIELD ENGINEERING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Requirements for Contractor's onsite recordkeeping.
  - 2. Contractor's field engineering.
  - 3. Contractor's surveying and layouts, and associated requirements.
  - 4. This section supplements the General Conditions' provisions on reference points and other matters.
- B. Scope:
  - 1. Contractor shall provide onsite recordkeeping, field engineering (not related to design of the completed Work), surveying and layout services, and professional services of the types indicated for the Project, including:
    - a. Furnishing civil, structural, geotechnical, electrical, and other professional engineering and geology services, whether required by the Contract Documents or necessary in Contractor's judgment, to perform Contractor's means, methods, techniques, sequences, and procedures of construction. Such services do not include professional services associated with delegation of professional design responsibility, which (when required as part of the Work) is addressed elsewhere in the Contract Documents.
    - b. Developing and making all detail surveys and measurements required for construction; including slope stakes, batter boards, and all other working lines, elevations, and cut sheets.
    - c. Providing materials required for Contractor's benchmarks, control points, batter boards, grade stakes, structure and pipeline elevation stakes, and other items.
    - d. Keeping a transit, theodolite, or total station (i.e., theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the Site at all times, and having a skilled instrument person available when necessary for laying out the Work and verifying lines, grades, and elevations.
    - e. Being solely responsible for all locations, dimensions, and levels of the Work. No data other than Change Order, Work Change Directive, or Field Order shall justify departure from dimensions and levels required by the Contract Documents.
    - f. Rectifying all Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments.
    - g. Providing such facilities and assistance necessary for Engineer and Resident Project Representative (if any) or Owner's Site Representative (if any) to check lines and grade points placed by Contractor.

##### **1.2 PRICE AND PAYMENT PROCEDURES**

- A. Unit Price Work:
  - 1. Do not perform excavation or embankment work until all cross-sectioning necessary for determining payment quantities for Unit Price Work have been completed and accepted by Engineer.

##### **1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:

1. Review requirements of this and other Specifications sections and coordinate other elements of the Work with field engineering, surveying, and layout Work and recordkeeping obligations set forth in this Specifications section..

#### **1.4 SUBMITTALS**

**A. Informational Submittals: Submit the following:**

1. Certificates:
  - a. When requested by Engineer following completion of the Work or a part thereof, submit certificate signed by professional engineer or professional surveyor, as applicable, indicating that elevations and locations of the Work comply with the Contract Documents. Explain each discrepancy, if any, from the requirements of the Contract Documents.
2. Contractor's Daily Reports and Field Engineering Records:
  - a. Submit daily reports as indicated in this Specification Section.
  - b. When requested by Engineer, submit documentation verifying accuracy of field engineering.
3. Contractor's Surveying Plan and Records:
  - a. Complete plan for performing surveying Work, submitted not less than 10 days prior to beginning surveying Work.
  - b. Example of proposed surveying field books to be maintained by Contractor's surveyor. Example surveying field book shall have sufficient information and detail, including example calculations and notes, to demonstrate that surveying field books will be organized and maintained in a professional manner in accordance with the Contract Documents.
  - c. Submit original surveying field books within two days after completing surveying Work.
  - d. Submit certified survey in accordance with this Specifications' section.
4. Qualifications Statements:
  - a. Field Engineer: Name, employer, and professional address. When requested by Engineer, submit qualifications, including detailed resume'.
  - b. Surveyor: Name, employer, professional address of firm, and detailed resumes of each professional land surveyor and crew chief that will be engaged in surveying Work. Submit not less than 10 days prior to beginning surveying Work. During the Project, submit detailed resume' for each new registered, licensed land surveyor and crew chief employed by or retained by Contractor not less than 10 days prior to starting on the surveying Work.

#### **1.5 CONTRACTOR'S ENGINEERS**

**A. Qualifications of Contractor's Field Engineer:**

1. Employ and retain at the Site a field engineer with experience and capability of performing all field engineering tasks required of Contractor, as indicated in this Article and elsewhere in the Contract Documents.
2. Contractor's field engineer shall possess not less than five years of experience performing duties similar in scope and complexity to those required of Contractor's field engineer on this Project.
3. Contractor's field engineer may serve as Contractor's Site superintendent, or as the recorder of as-constructed conditions in accordance with Section 01 78 39 - Project Record Documents, or as any combination of these roles as deemed appropriate by Contractor.
4. Maintain at the Site full-time superintendent or field engineer fluent in written and spoken English language.

**B. Responsibilities of Contractor's Field Engineer:**

1. Daily Reports:
  - a. Prepare and maintaining daily reports of activity on the Contract. Submit reports to Engineer. Contractor's daily reports shall indicate the following information:

- 1) Contractor's Employees: Number of Contractor's employees at the Site, apportioned by trade(s).
- 2) Subcontractors: Separately indicate and identify each Subcontractor and the number of workers onsite for each. Apportion number of workers by trade(s).
- 3) Equipment and materials installed as part of the Work.
- 4) Equipment and materials, to be installed in the Work, delivered to the Site or offsite storage location that day. When delivered to offsite storage, indicate the storage location.
- 5) Major construction equipment utilized by major activity. Indicate for each manufacturer, model number, and year of manufacture.
- 6) Location of areas in which construction was performed.
- 7) Work performed, including field quality control activities such as inspections and testing. Indicate field quality control activities witnessed by Engineer, Resident Project Representative (if any), or Owner's Site Representative (if any).
- 8) Weather conditions, including minimum and maximum ambient air temperatures, relative humidity, conditions of high winds or other extreme weather, and precipitation.
- 9) Safety concerns, events, and precautions taken.
- 10) Defective Work observed or believed to exist.
- 11) Delays encountered, extent of delay incurred, reasons for the delay, and measures that will be taken to rectify delays encountered.
- 12) Acknowledgement of specific instructions received from Engineer, Resident Project Representative (if any), Owner, or Owner's Site Representative (if any).
- 13) Visitors to the Site.
- 14) Other notable events occurring on the Project.
- b. Daily reports shall be signed and dated by responsible member of Contractor's staff, such as Contractor's field engineer, superintendent, project manager, or foreman designated by Contractor as having authority to sign daily reports.
- c. Submit Contractor's daily reports by 9:00 a.m. (local time at the Site) the next working day after the day covered in the associated report.
2. Check all formwork, reinforcing materials, inserts, structural steel, masonry, insulation, waterproofing and element protection, doors and windows, finishes, bolts, sleeves, piping, other materials and equipment for compliance with the Contract Documents.
3. Continually inspect the Work to ensure that the quality and quantities required by the Contract Documents are provided.
4. Promptly report defective Work to Contractor, Engineer, Resident Project Representative (if any), and Owner's Site Representative (if any).
5. Cooperate as required with Engineer, Resident Project Representative (if any), and Owner's Site Representative (if any) in observing the Work and performing field inspections and other field quality control activities.
6. Check and coordinate the Work for conflicts and interferences, and immediately advise Engineer and Resident Project Representative (if any) of all discrepancies of which Contractor is aware.
7. Maintain field office files and drawings, record documents, and coordinate field engineering services with Subcontractors and Suppliers as appropriate, and other prime contractors (if any).
8. Supervise or personally prepare and maintain Project record documents in accordance with Section 01 78 39 - Project Record Documents.
9. Prepare layout and coordination drawings for construction operations.
10. Review and coordinate the Work with Shop Drawings approved by Engineer, other Submittals accepted by Engineer, and Contractor's means, methods, techniques, sequences, and procedures of construction and safety programs incident thereto.
11. Coordinate onsite work of Subcontractors and Suppliers, or assist Contractor's Site superintendent in doing so.

- C. Design Professionals Services Retained by Contractor (whether or not stationed at the Site):
  - 1. Delegated Professional Design Services:
    - a. Where the Contract Documents require Contractor to furnish professional engineering, geology, or architecture services as delegated professional design, the provisions of the General Conditions, Specifications, and other Contract Documents regarding delegated design responsibility apply.
  - 2. Design Professional Services that are Not Delegated Professional Design of the Completed Work:
    - a. Where the Contract Documents require that Contractor retain a design professional such as a professional engineer, geologist, or architect, or when in Contractor's judgment retaining such entity is necessary for implementing Contractor's means, methods, techniques, sequences, or procedures of construction or safety and protection programs incident thereto, retain a design professional with necessary skills, experience, and qualifications to perform the required services. Where required by the Contract Documents or by Laws or Regulations, such entity shall be duly licensed and registered to perform the associated design professional services in the same jurisdiction as the Site, unless otherwise allowed by Laws or Regulations or by the Contract Documents.
    - b. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed by such design professional(s).

## **1.6 CONTRACTOR'S SURVEYOR**

- A. Qualifications:
  - 1. Employ or retain the services, as needed, at the Site a surveyor with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work. Comply with Laws and Regulations governing land surveying.
  - 2. Contractor's surveyor shall possess not less than five years of experience performing duties similar in scope and complexity to those required of Contractor's surveyor on this Project.
- B. Responsibilities of Contractor's Surveyor:
  - 1. Providing required surveying equipment, including transit, theodolite, or total station; level; stakes; and surveying accessories.
  - 2. Establishing required lines and grades for constructing all facilities, structures, pipelines, and site improvements, including outdoor electrical equipment and feeders.
  - 3. Preparing and maintaining professional-quality, accurate, well-organized, legible notes of all measurements and calculations made while surveying and laying out the Work.
  - 4. Prior to backfilling operations, survey, locate, and record on a copy of the Drawings accurate representation of buried Work and Underground Facilities provided and encountered.
  - 5. Locating on a site plan of the Site the actual location of above-ground Work to be indicated on record documents.
  - 6. Complying with requirements of the Contract Documents relative to surveying and related Work, including requirements of this Specification section's Articles 1.6 and 3.1.

## **1.7 RECORDS**

- A. Records – General:
  - 1. Maintain at the Site:
    - a. Contractor's field engineer's daily reports, with information and submitted in accordance with Article 1.5 of this Specification Section.
    - b. Information and documents required by Section 01 78 39 - Project Record Documents.
    - c. Complete and accurate log of control and survey Work as such Work progresses.
    - d. Other records deemed by Contractor to be necessary or appropriate.
- B. Field Books and Records:

1. Survey data and records shall be in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standard of care in the locality where the Site is located.
  2. Original field notes, calculations, and other surveying data shall be recorded by Contractor's surveyor in Contractor-furnished hard-bound field books, and shall be signed and sealed by Contractor's surveyor.
  3. Completeness and accuracy of surveying Work, and completeness and accuracy of surveying records, including field books, shall be responsibility of Contractor.
  4. Unacceptable Records of Contractor's Surveyor:
    - a. Failure to organize and maintain survey records in an appropriate manner that allows reasonable and independent verification of calculations, and to allow identification of elevations, lines, locations, dimensions, and grades of the Work, shall be cause for rejecting the surveying records, including field books.
    - b. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by Engineer.
    - c. Other provisions of the Contract notwithstanding, Contractor shall have sole responsibility for uncovering, re-surveying, and restoring uncovered Work should survey data be unacceptable to Engineer.
- C. Certified Survey of Surface Structures:
1. Upon completion of foundation walls and major site improvements, prepare a certified survey, signed and sealed by professional surveyor, showing or indicating dimensions, locations, angles and elevations of construction and locations and elevations of Underground Facilities installed and encountered during the Work.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 SURVEYING**

- A. Reference Points:
1. Refer the General Conditions, as may be modified by the Supplementary Conditions, for requirements regarding reference points.
  2. Owner's established reference points that are damaged or destroyed by Contractor will be re-established by Owner at Contractor's expense. Owner may deduct from payments due Contractor such amounts as set-offs in accordance with the Contract Documents.
  3. From Owner-established reference points, establish lines, grades, and elevations necessary to control the Work. Obtain measurements required for performing the Work to tolerances indicated in the Contract Documents.
  4. Establish, place, and replace as required, such additional stakes, markers, and other reference points necessary for controlling the Work and verifying accuracy and compliance with the Contract Documents.
- B. Surveys to Determine Quantities for Payment:
1. For each application for progress payment, perform such surveying and calculations necessary to determine quantities of Work performed or placed, including Unit Price Work. Perform surveying necessary for Engineer to determine final quantities of Work in place.
  2. Advise Engineer, Resident Project Representative (if any), and Owner's Site Representative (if any) not less than 24 hours before performing surveying services for determining quantities to be included in Application for Payment. Unless waived in writing by Engineer, perform quantity surveys in presence of Engineer or Resident Project Representative (if any).

- C. Construction Surveying: Comply with the following:
1. Alignment Staking: Provide alignment stakes at 50 feet intervals on tangent, and at 25 feet intervals on curves.
  2. Slope Staking: Provide slope staking at 50 feet intervals on tangent, and at 25 feet intervals on curves. Re-stake at every ten-foot difference in elevation.
  3. Structure: Stake-out structures, including elevations, and check prior to and during construction.
  4. Pipelines: Stake-out pipelines including elevations, and check prior to and during construction.
  5. Roads, Drives, and Paved Areas: Stake-out roadway, driveway, and paved area elevations at 50-foot intervals on tangent, and at 25 feet intervals on curves.
  6. Cross-Sections: Provide original, intermediate, and final staking as required, for site work and other locations as necessary for quantity surveying.
  7. Easement Staking: Provide easement staking at 50 feet intervals on tangent, and at 25 feet intervals on curves. Also provide wooden laths with flagging at maximum intervals of 100 FT.
  8. Record Staking: Provide permanent stake at each blind flange and each utility cap provided for future connections. Stakes for record staking shall be material acceptable to Engineer, durably installed for long-term reference by Owner, utility owners, and others as necessary.
- D. Accuracy:
1. Establish Contractor's temporary survey references points for Contractor's use to not greater than second-order accuracy (i.e., 1:10000). Construction staking used as a guide for the Work shall be set at not greater than third-order accuracy (i.e., 1:5000). Basis on which such orders are established shall provide the absolute margin for error specified below.
  2. Horizontal accuracy of easement staking shall be plus or minus 0.1 feet. Accuracy of other staking shall be plus or minus 0.04 feet horizontally and plus or minus 0.02 feet vertically.
  3. Survey calculations shall include an error analysis sufficient to demonstrate required accuracy.

## **END OF SECTION**

**SECTION 01 73 20**  
**OPENINGS AND PENETRATIONS IN CONSTRUCTION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Methods of installing and sealing openings and penetrations in construction.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 05 50 00 - Miscellaneous Metals.
  - 4. Section 06 82 00 - Fiberglass Reinforced Plastic Fabrications.
  - 5. Section 07 62 00 - Flashing and Sheet Metal.
  - 6. Section 07 92 00 - Joint Sealants.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A36, Standard Specification for Carbon Structural Steel.
    - b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - c. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
    - d. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
    - e. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
    - f. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
    - g. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
    - h. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
    - i. A995, Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts.
  - 2. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC):
      - 1) Article 501, Class 1 Locations.
    - b. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
    - c. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

**1.3 DEFINITIONS**

- A. Corrosive Areas: For the purpose of this specification section, the following areas are defined as corrosive:
  - 1. Continually wet areas.
- B. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.
- C. Washdown Areas: Areas having floor drains or hose bibbs.

## **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. For each structure provide dimensioned or scaled (minimum 1/8 IN = 1 FT) plan view drawings containing the following information:
    - a. Vertical and horizontal location of all required openings and penetrations.
    - b. Size of all openings and penetrations.
    - c. Opening type.
    - d. Seal type.
  - 3. Manufacturer's installation instructions for standard manufactured products.

## **1.5 PROJECT CONDITIONS**

- A. For purposes of this Project, water table level is assumed to be 3 feet below grade.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Pipe Sleeves:
  - 1. Areas listed as Corrosive Areas in PART 1:
    - a. Stainless steel, Type 304L
    - b. Penetrations 24 IN DIA or less: ASTM A269, ASTM A312 or ASTM A554, Schedule 40.
    - c. Penetrations larger than 24 IN DIA: Stainless steel, ASTM A666, Minimum 1/4 IN thickness.
  - 2. All other Areas:
    - a. Steel, Hot-dipped galvanized after fabrication.
    - b. Penetrations 24 IN DIA or less: ASTM A53, Schedule 40.
    - c. Penetrations larger than 24 IN DIA: ASTM A36, Minimum 1/4 IN thickness.
- B. Backing Rod and Sealant: See Specification Section 07 92 00.
- C. Modular Mechanical Seals:
  - 1. Acceptable manufacturers:
    - a. Link-Seal.
    - b. PSX: Direct Drive Press Seal
  - 2. 304 stainless steel bolts, nuts and washers.
- D. Sheet Metal Sleeves:
  - 1. Areas listed as Corrosive Areas in PART 1: Stainless steel: ASTM A240, Type 304L.
  - 2. All other areas: Galvanized steel: ASTM A653, G90.
  - 3. Minimum 12 GA.
- E. Commercial Wall Castings:
  - 1. Ductile iron, ASTM A536.
  - 2. Grade equal to connecting piping system.

## **PART 3 - EXECUTION**

### **3.1 FABRICATION**

- A. Fabricate pipe sleeves in accordance with Specification Section 05 50 00.
- B. Fabricate sheet metal sleeves in accordance with Specification Section 07 62 00.
- C. Provide waterstop plate/anchor flange for piping, ducts, castings and sleeves cast-in-place in concrete.



1. For fabricated units, weld plate to sleeve, pipe, or ductwork.
2. For commercial castings, cast water stop/anchor with wall pipe.
3. Plate is to be same thickness as sleeve, pipe, casting or ductwork.
4. For fabricated units, diameter of plate or flange to be 4 IN larger than outside diameter of sleeve, pipe or ductwork.
5. For commercial castings, waterstop/anchor size to be manufacturer standard.
6. Provide continuous around entire circumference of sleeve, pipe, or ductwork.

### **3.2 INSTALLATION AND APPLICATION**

- A. Seal openings and penetrations in non-fire-resistance-rated construction in accordance with Specification Section 07 92 00.
- B. Obtain prior approval from Engineer when any opening larger than 100 SQIN must be made in existing or newly completed construction.
- C. Perform HVAC penetrations in accordance with NFPA 90A.
- D. Perform electrical penetrations in accordance with NFPA 70, Article 501.
- E. When mechanical or electrical work cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, insets, fixtures or devices necessary to permit installation later.
  1. Lay out chases, holes or other openings which must be provided in masonry, concrete or other work.
- F. Where pipes, conduits or ducts pass through floors in washdown areas, install sleeves with top 3 IN above finish floors.
  1. In non-washdown areas, install sleeves with ends flush with finished surfaces.
- G. Size sleeves, blockouts and cutouts which will receive sealant seal such that free area to receive sealant is minimized and seal integrity may be obtained.
- H. For insulated piping and ducts, size sleeves, blockouts and cutouts large enough to accommodate full thickness of insulation.
- I. Where pipes, conduits or ducts pass through grating, provide banding at the entire perimeter of the opening.
  1. Metal grating: See Specification Section 05 50 00.
  2. FRP grating: See Specification Section 06 82 00.
- J. Where pipes, conduits or ducts are removed where passing through grating:
  1. Metal grating:
    - a. Provide banding at perimeter and cover opening with 1/4 IN plate of the same material of the grating.
    - b. See Specification Section 05 50 00.
  2. FRP grating:
    - a. Provide full depth cover meeting same loading requirement as existing material or replace grating section.
    - b. See Specification Section 06 82 00.
- K. Do not cut into or core drill any beams, joists, or columns.
- L. Do not install sleeves in beams, joists, or columns.
- M. Do not install recesses in beams, joists, columns, or slabs.
- N. Field Cutting and Coring:
  1. Saw or core drill with non-impact type equipment.
  2. Mark opening and drill small 3/4 IN or less holes through structure following opening outline.
  3. Sawcut opening outline on both surfaces.

- a. Knock out within sawcuts using impact type equipment.
  - b. Do not chip or spall face of surface to remain intact.
  - c. Do not allow any overcut with saw kerf.
- O. Precast-Prestressed Concrete Construction:
  - 1. Do not cut openings or core drill vertically or horizontally through stems of members.
  - 2. Do not locate or install sleeves or recess sleeves vertically or horizontally through or in stems of members.
  - 3. Cast openings and sleeves into flanges of units.
  - 4. Cast openings larger than 6 IN in diameter or 6 IN maximum dimension in units at time of manufacture.
  - 5. Cast openings smaller than 6 IN in diameter or 6 IN maximum dimensions in flanges of units at time of manufacture or field cut.
- P. Where area is blocked out to receive sheet metal sleeve at later date:
  - 1. If blockout size is sufficient to allow placement, utilize dowels for interface of initially placed concrete and sleeve encasement concrete which is placed later.
    - a. Size blockout based on sleeve size required plus 4 to 6 IN each side of sleeve for concrete encasement.
    - b. Provide #4 dowels at 12 IN spacing along each side of blockout with minimum of two (2) dowels required per side.
  - 2. If blockout size is not sufficient to allow placement of dowels, provide keyway along all sides of blockout.
    - a. Size blockout based on sleeve size required plus 2 to 4 IN each side of sleeve for concrete encasement.
- Q. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.
- R. Use full depth expanding foam sealant for seal applications where single or multiple pipes, conduits, etc., pass through a single sleeve.
- S. Do not make duct or conduit penetrations below high water levels when entering or leaving tankage, wet wells, or other water holding structures.
- T. Modular Mechanical Seals:
  - 1. Utilize one (1) seal for concrete thickness less than 8 IN and two (2) seals for concrete, 8 IN thick or greater.
  - 2. Utilize two (2) seals for piping 16 IN diameter and larger if concrete thickness permits.
  - 3. Install seals such that bolt heads are located on the most accessible side of the penetration.
- U. Backer Rod and Sealant:
  - 1. Install in accordance with Specification Section 07 92 00.
  - 2. Provide backer rod and sealant for modular mechanical seal applications.
    - a. Apply on top side of slab penetrations and on interior, dry side wall penetrations.

### 3.3 SCHEDULES

- A. General Schedule of Penetrations through Floors, Roofs, Foundation Base Slabs, Foundation Walls, Foundation Footings, Partitions and Walls for Ductwork, Piping, and Conduit:
  - 1. Provide the following opening and penetration types:
    - a. Type A - Block out 2 IN larger than outside dimensions of duct, pipe, or conduits.
    - b. Type B - Saw cut or line-drill opening. Place new concrete with integrally cast sheet metal or pipe sleeve.
    - c. Type C - Fabricated sheet metal sleeve or pipe sleeve cast-in-place. Provide pipe sleeve with water ring for wet and/or washdown areas.
    - d. Type D - Commercial type casting or fabrication.
    - e. Type E - Saw cut or line-drill opening. Place new concrete with integrally cast pipe, duct or conduit spools.

- f. Type F - Integrally cast pipe, duct or conduit.
  - g. Type G - Saw cut or line-drill and remove area 1 IN larger than outside dimensions of duct, pipe or conduit.
  - h. Type H - Core drill.
  - i. Type I - Block out area. At later date, place new concrete with integrally cast sheet metal or pipe sleeve.
  - j. Type J- Grating Banding for any field cut openings.
2. Provide seals of material and method described as follows.
- a. Category 1 - Modular Mechanical Seal.
  - b. Category 2 - Roof curb and flashing according to SMACNA specifications unless otherwise noted on Drawings. Refer to Specification Section 07 62 00 and roofing Specification Sections for additional requirements.
  - c. Category 3 - 12 GA sheet metal drip sleeve set in bed of silicon sealant with backing rod and sealant used in sleeve annulus.
  - d. Category 4 - Backer rod and sealant.
  - e. Category 5 - Full depth compressible sealant with escutcheons on both sides of opening.
  - f. Category 6 - Full depth compressible sealant and flanges on both sides of opening. Flanges constructed of same material as duct, fastened to duct and minimum 1/2 IN larger than opening.
  - g. Category 7 - Full depth compressible sealant and finish sealant or full depth expanding foam sealant depending on application.
  - h. Category 8 - Banding for all grating openings and banding and cover plate of similar materials for abandoned openings.
3. Furnish openings and sealing materials through new floors, roofs, grating, partitions and walls in accordance with Schedule A, Openings and Penetrations for New Construction.

**SCHEDULE A. OPENINGS AND PENETRATIONS SCHEDULE  
FOR NEW CONSTRUCTION**

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
	I					
Through floors on grade above water table	C F I	4 Not Req 4	C F I <sup>(1)</sup>	7 Not Req 7	C F I <sup>(1)</sup>	4 Not Req 7
Through slab on grade below water table	F	Not Req	F	Not Req	F	Not Req
Through floors in washdown areas	C I	4 4	C H <sup>(2)</sup> I <sup>(1)</sup>	4 3 4	F H <sup>(2)</sup> I <sup>(1)</sup>	Not Req 3 7
Through exterior wall below grade above water table	C F I	7 Not Req 7	C D F I <sup>(1)</sup>	1 Not Req Not Req 1	F I <sup>(1)</sup>	Not Req 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	C F I	7 Not Req 7	C D F H <sup>(2)</sup>	1 Not Req Not Req 1	C F H <sup>(2)</sup> I <sup>(1)</sup>	7 Not Req 7 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	F	Not Req	F	Not Req	F	Not Req
Through exterior wall above grade	A B C	6 6 6	A B D H <sup>(2)</sup>	5 5 Not Req 5	C H <sup>(2)</sup>	5 4
Roof penetrations	A	2	A	2	A	2
Through interior walls and slabs not covered by the above applications	A C	4 4	A C	4 4	A C F	4 4 Not Req
Grating openings and penetrations	J	8	J	8	J	8

**END OF SECTION**

**SECTION 01 73 29**  
**DEMOLITION, CUTTING AND PATCHING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Demolition, cutting and patching of existing construction where shown on Drawings, or as required to accommodate new work shown or specified.
  - 2. Removal and protection of items identified to be saved or reused.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 03 31 30 - Concrete, Materials and Proportioning.
  - 4. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
  - 5. Section 09 96 00 - High Performance Industrial Coatings.
  - 6. Section 31 23 00 - Earthwork.
  - 7. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.

**1.2 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Provide documentation of demolition and removal. Indicate limits and sequencing to be used. Show and identify any items to be kept for USER reuse or retention.
  - 3. Provide schedule of demolition activities including overall schedule, planned utility interruptions, interruptions of USER services and traffic control if required.
  - 4. Indicating manufacturer and type of:
    - a. Proposed non-shrink grout.
    - b. Epoxy bonding adhesive.
    - c. Proposed materials and methods to be used for matching and repairing existing construction.

**1.3 DESCRIPTION**

- A. This section covers cut and patch work either in remodel, add-on or new construction as necessary for execution of the Work.
- B. Install Work in such a manner and sequence as to preclude or minimize cutting and patching of new Work.
- C. Execute cutting, including excavation, fitting or patching of Work, required to:
  - 1. Make several parts fit properly.
  - 2. Uncover Work to provide for installation of ill-timed Work.
  - 3. Remove and replace defective Work.
  - 4. Remove and replace non-conforming Work.
  - 5. Remove samples of installed Work for testing.
  - 6. Install specified Work in existing construction.
  - 7. Provide rerouting penetrations of non-structural surfaces for installation of piping and electrical conduit.
  - 8. Patch and repair fireproofing damaged after installation of other Work or demolition activities.
  - 9. Remove and finish construction at connections to other structures.
  - 10. Remove existing roofing where required by new Work, and patch to match existing roofing.

- D. Do not endanger any Work or Work of other Contractors, by cutting, excavating, or otherwise altering Work except with written consent of Contractor subject to review by Architect.
- E. Do not cut into or cut away structural concrete, other concrete or other structural members nor dig under foundations or into structural walls or other parts, or in any case allow same to be done without full knowledge and written consent of Architect.
- F. Repair or replace damaged work resulting from violation of these provisions.
- G. Use only firms or individual trades qualified to perform Work required under this Section.

#### **1.4 QUALITY ASSURANCE**

- A. Employ skilled persons experienced with material requiring cutting and patching.
  - 1. To the greatest extent practicable, employ original installer to perform cutting and patching for weather-exposed and moisture-resistant components, and sight-exposed surfaces.
- B. Written Requests:
  - 1. Submit requests in advance of cutting or alteration which affects:
    - a. Structural integrity of any component of Project.
    - b. Integrity of weather-exposed or moisture-resistant component.
    - c. Efficiency, maintenance, or safety of an operational component.
    - d. Visual qualities of sight-exposed components.
    - e. Work of USER or separate contractor.
  - 2. Include in Request:
    - a. Location and description of affected work.
    - b. Necessity for cutting or alteration.
    - c. Description of proposed work, and products to be used.
    - d. Alternatives to cutting and patching.
    - e. Effect on work of USER or separate contractor.
    - f. Written permission of affected separate contractor.
    - g. Date and time work will be executed.
- C. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- D. Operational Limitations:
  - 1. Cut and patch operating elements or related components in a manner that results in maintaining their capacity to perform as intended.
  - 2. Cut and patch operating elements or related components in a manner that does not result in increased maintenance or decreased operational life or safety.
- E. Structural Work:
  - 1. Cut and patch structural elements in a manner that maintains their load-carrying capacity or load-deflection ratio.
  - 2. Follow applicable NFPA Standards when torch cutting is required.
- F. Visual Requirements:
  - 1. Cut and patch construction exposed on exterior or in occupied spaces in a manner to, in Architect's opinion, retain the building's aesthetic or visual qualities.
  - 2. Cut and patch construction in a manner to avoid visual evidence of cutting and patching.
  - 3. Remove and replace construction which was cut and patched in a visually unsatisfactory manner.
- G. Warranties and Existing Warranties:
  - 1. Replace, patch, and repair material and surfaces cut or damaged by methods and with materials and in such manner to maintain warranties.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. General:
  - 1. Salvage items, designated for USER's salvage, as a functional unit.

2. Clean, list and tag for storage.
3. Protect from damage and deliver to location designated.
4. Salvage each item with auxiliary or associated equipment required for operation.

## **1.6 PROJECT CONDITIONS**

- A. Perform preliminary investigations as required to ascertain extent of work.

## **1.7 SEQUENCING AND SCHEDULING**

- A. Coordinate and reschedule work as required to preclude interference with other operations.

# **PART 2 - PRODUCTS**

## **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
  1. Epoxy bonding adhesive:
    - a. Euco No.452 MV by Euclid Chemical Co.
    - b. Sikadur 32, Hi-Mod by Sika Corporation.
  2. Epoxy patch:
    - a. Depth of patch:
      - 1) Greater than 3/4 IN: Five Star MP Epoxy Patch.
      - 2) Between 1/8 IN and 3/4 IN: Five Star Fluid Epoxy.
- B. Submit request for substitution in accordance with Specification Section 00 72 13.

## **2.2 MATERIALS**

- A. Use materials identical to existing materials.
- B. For exposed surfaces, use materials that visually match existing adjacent surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used.
- C. Use materials whose installed performance will equal or surpass that of existing materials.
- D. Where applicable, comply with specifications for type of Work to be performed.
- E. Temporary Partitions:
  1. Plywood: 1/2 IN minimum for interior or exterior use.
  2. Paneling: 1/4 IN minimum for interior use.
- F. Non-shrink Grout:
  1. See Section 03 31 30.
- G. Epoxy Bonding Adhesive:
  1. Two component, moisture insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.

# **PART 3 - EXECUTION**

## **3.1 PREPARATION**

- A. Provide and maintain temporary partitions as required in public areas.
  1. Construct partitions of braced plywood in exterior areas.
  2. Adequately braced paneling may be used in interior areas.
- B. Provide and maintain covered passageways where necessary to ensure safe passage of persons in or near areas of work.
- C. Provide and maintain substantial barricades and safety lights as required.

- D. Provide and maintain temporary dustproof partitions where indicated or necessary.
  - 1. Prevent infiltration of dust into occupied areas.
- E. Provide and maintain temporary weather protection as necessary.
- F. Provide adequate temporary bracing to maintain safety, stability and to resist all loads to which the structure may be subjected.

### 3.2 DEMOLITION

- A. Cutting and Removal:
  - 1. Remove existing work indicated to be removed, or as necessary for installation of new work.
  - 2. Neatly cut and remove materials, and prepare all openings to receive new work.
  - 3. Remove masonry or concrete in small sections.
- B. Modification of Existing Concrete:
  - 1. Where indicated, remove existing concrete and finish remaining surfaces as specified in Specification Section 03 35 00.
    - a. Make openings by sawing through the existing concrete.
      - 1) Core drill with 6 IN DIA core at the corners of rectangular openings to avoid overcutting at corners.
    - b. Break out concrete after initial saw cuts in the event concrete thickness prevents cutting through.
    - c. Where saw cutting is not possible, make openings by drilling holes around perimeter of opening and then chipping out the concrete.
      - 1) Holes shall be sufficient in number to prevent damage to remaining concrete.
  - 2. Oversize required openings in existing concrete 1 IN on all sides and build back to required opening size by means of grout epoxy bonded to the existing concrete.
  - 3. Where oversized openings cannot be made, remove the concrete to the required opening size and cut back exposed reinforcing 1 IN from face of concrete and fill resulting holes with bonding agent and non-shrink grout.
    - a. At liquid containing structures, coat entire surface with cementitious waterproofing mortar.
  - 4. Protect remaining concrete from damage.
    - a. If existing concrete to remain becomes damaged, cease demolition and make corrections as required to avoid further damage.
    - b. Notify Engineer immediately of any damage to remaining concrete.
- C. Removal of Existing Anchor Bolts or Other Protruding Elements:
  - 1. Remove all protruding elements.
  - 2. Remove to a depth of 1/4 IN from finished surface.
  - 3. Fill void with epoxy patch.
- D. Matching and Patching:
  - 1. Walls, ceilings, floors or partitions:
    - a. Repair abutting walls, ceilings, floors or partitions disturbed by removal.
    - b. Match and patch existing construction disturbed during installation of new work.
  - 2. Methods and materials:
    - a. Similar in appearance, and equal in quality to adjacent areas for areas or surfaces being repaired.
    - b. Subject to review of OWNER.
  - 3. Reinforcing steel that is cut and exposed:
    - a. Remove to a depth of 1/4 IN.
    - b. Fill void with epoxy patch.
- E. Salvaged Items:
  - 1. Thoroughly dry and clean all metal surfaces.
  - 2. Clean and lubricate motors and other moving parts.



3. Brace motors attached to flexible mountings until reinstallation.
4. Dispose of items or materials not designated for USER's salvage or reuse.
  - a. Promptly remove from site.
5. Do not store or sell Contractor salvaged items or materials on-site.
6. Carefully remove items to be salvaged and reused or to be delivered to USER's storage.
  - a. Store and protect items indicated on Drawings or those which have been marked by USER to be salvaged or to be reused in Work.
  - b. Replace any item damaged through carelessness in removal, storage, or handling with new items of same type.
  - c. Do not reuse materials or equipment not specifically indicated or specified to be reused.
7. Preparation of equipment for storage:
  - a. Identify each component with markings or tags to show its position in the assembly and the assembly of which it belongs.
  - b. Place small parts of wooden boxes and clearly mark contents on the outside.
  - c. Remove oil from oil-lubricated bearings and gear boxes and replace with storage oil.
  - d. Grease grease-lubricated bearings.
  - e. Replace any breather plug with solid plug.
  - f. Megger test motor windings: Attach report of the test results to the unit and furnish one (1) copy to the Engineer.
  - g. Attach unit to suitable crate bottom.
  - h. Enclose unit in polyethylene film and seal all seams and the film to the base of the unit with tape.
  - i. Construct crate of wooden slats around top and sides of unit.
  - j. Attach permanent instruction tag to outside of crate stating "This unit has been prepared for storage--replace oil, vent plugs, and lubricant in accordance with manufacturer's instructions before start-up."

F. Clean Up: Transport debris and legally dispose of off-site.

### **3.3 SCHEDULE**

A. Items to be Salvaged to USER: None.

## **END OF SECTION**

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## **SECTION 01 74 23**

### **CLEANING**

#### **PART 1 - GENERAL**

##### **1.1 FIRE PROTECTION**

- A. Store volatile waste in listed disposal containers.
- B. Maintain site and building so no condition provides a fire hazard.
- C. Remove combustible debris from building at end of each shift and from site daily.
- D. Sources of ignition and smoking are prohibited in flammable and combustible storage areas.
- E. Do not burn on-site.

##### **1.2 POLLUTION CONTROL**

- A. Conduct cleanup and disposal operations to comply with codes, rules, regulations, ordinances, and anti-pollution laws.
- B. Do not burn or dispose of combustible debris, rubbish and waste material on site.
- C. Do not discharge volatile, harmful, or dangerous materials into storm or sanitary drains or sewer systems.
- D. Prevent accumulation of wastes that create hazardous conditions.

#### **PART 2 - PRODUCTS**

##### **2.1 CLEANING MATERIALS**

- A. Use materials recommended by manufacturers of surfaces to be cleaned.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.
- C. Use only those cleaning materials which will not create hazards to health or property and will not damage surfaces.

#### **PART 3 - EXECUTION**

##### **3.1 GENERAL**

- A. Clean items installed under this Contract.
  - 1. Leave free of stains, dirt, dust, damage, or defects.
  - 2. Include washing, sweeping, polishing of wall surfaces, floors, windows, hardware, mirrors, lighting fixtures, equipment, etc.

##### **3.2 DURING CONSTRUCTION**

- A. Provide on-site listed disposal containers for collection of waste materials, debris, and rubbish.
  - 1. Dispose of off site once a week at an approved solid waste disposal site.
  - 2. Cover container to prevent blowing by wind.
- B. Keep work areas clean so as not to hinder health, safety or convenience of personnel in existing facility operations.
- C. Interior cleaning:
  - 1. Clean and vacuum interior space prior to start of painting, and continue cleaning as-needed until substantial completion.
  - 2. Schedule cleaning operations so contaminants do not fall on wet painted surfaces.

3. Clean and protect Work in progress and adjoining materials in place, during handling and installation.
  4. Clean lunch/break area after each use.
- D. Exterior cleaning:
1. Wet down dusty materials and rubbish to prevent blowing dust during entire construction period.
  2. If use of water is prohibited by law, seek an alternate method to prevent blowing dust.
  3. Perform cleaning operations as required during construction to prevent accumulations of dust, soil, and debris.
  4. Keep weeds and other vegetation trimmed to 3 IN maximum height.
  5. Remove snow and ice from access to buildings.

### **3.3 FINAL CLEANING**

- A. At Substantial Completion, perform final cleaning of Work and existing areas wherever any area are left less than clean by construction operations.
1. Complete cleaning operations before requesting review for Substantial Completion.
- B. Use experienced professional cleaners for final cleaning.
- C. Repair and touch-up marred areas.
- D. Broom clean and remove stains from paved surfaces; rake clean other surfaces of grounds.
- E. Ventilation systems:
1. Clean permanent filters and replace disposable filters if units were operated during construction.
  2. Clean ducts, blowers, and coils in air conditioning units operated during construction.
- F. Remove grease, dust, dirt, stains, labels, fingerprints, mastic, adhesive, and foreign materials from interior and exterior surfaces, and fixtures, hardware, and equipment.
- G. Wash and shine glazing, mirrors, stainless steel, etc., including existing windows in area of construction.
- H. Wipe all lighting fixture reflectors, lenses, lamps and trims clean.
1. Replace all burned out lamps.
- I. Polish glossy surfaces to a clear shine.
- J. Remove temporary protection and facilities installed for protection of the Work during construction.

### **3.4 FIELD QUALITY CONTROL**

- A. Prior to USER occupancy, Contractor and Owner shall conduct an inspection of interior and exterior surfaces and Work areas to verify Project is clean to Owner's satisfaction.

## **END OF SECTION**

**SECTION 01 75 00**  
**[SYSTEM] [FACILITY] START-UP**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Procedures and actions, required of the Contractor, which are necessary to achieve and demonstrate Substantial Completion.
  - 2. Requirements for Substantial Completion Submittals.
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 01 61 03 - Equipment: Basic Requirements.

**1.2 DEFINITIONS**

- A. Project Classified System (PCS): A defined part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, wiring, materials, or incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system.
- B. Pre-Demonstration Period: The period of time, of unspecified duration after initial construction and installation activities during which Contractor, with assistance from manufacturer's representatives, performs in the following sequence:
  - 1. Finishing type construction work to ensure the Project has reached a state of Substantial Completion.
  - 2. Equipment start-up.
  - 3. Personnel training.
- C. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates process flow through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.
- D. Substantial Completion: Section 01 77 00.

**1.3 SUBMITTALS**

- A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- B. Submit in the chronological order listed below prior to the completion of the Pre-Demonstration Period.
  - 1. Master operation and maintenance training schedule:
    - a. Submit 30 days (minimum) prior to first training session for USER's personnel.
    - b. Schedule to include:
      - 1) Target date and time for USER witnessing of each system initial start-up.
      - 2) Target date and time for Operation and Maintenance training for each system, both field and classroom.
      - 3) Target date for initiation of Demonstration Period.
    - c. Submit for review and approval by Owner.
    - d. Include holidays observed by USER.

- e. Attend a schedule planning and coordination meeting 90 calendar days prior to first anticipated training session.
  - 1) Provide a status report and schedule-to-complete for requirements prerequisite to manufacturer's training.
  - 2) Identify initial target dates for individual manufacturer's training sessions.
- f. USER reserves the right to insist on a minimum seven (7) days' notice of rescheduled training session not conducted on master schedule target date for any reason.
- g. Schedule to be resubmitted until approved.
- 2. Substantial Completion Submittal:
  - a. File Contractor's Notice of Substantial Completion and Request for Inspection.
  - b. Approved Operation and Maintenance manuals received by Owner minimum 30 days prior to scheduled training.
  - c. Written request for Engineer to witness each system pre-demonstration start-up.
    - 1) Request to be received by USER minimum one (1) week before scheduled training of USER's personnel on that system.
  - d. Equipment installation and pre-demonstration start-up certifications.
  - e. Letter verifying completion of all pre-demonstration start-up activities including receipt of all specified items from manufacturers or suppliers as final item prior to initiation of Demonstration Period.

#### **1.4 SEQUENCING AND SCHEDULING**

- A. Phased Construction:
  - 1. None.
- B. Schedule of Events:
  - 1. None.

#### **1.5 COST OF START-UP**

- A. Contractor to pay all costs associated with Facility start-up.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Facility Start-up Divided into Two Periods:
  - 1. Pre-Demonstration Period including:
    - a. Completion of construction work to bring Project to a state of Substantial Completion.
    - b. Start-up of Equipment.
    - c. Training of Personnel.
    - d. Completion of the filing of all required submittals.
    - e. Filing of Contractor's Notice of Substantial Completion and Request for Inspection.
  - 2. Demonstration Period including:
    - a. Demonstration of functional integrity of facility or PCS.

#### **3.2 PRE-DEMONSTRATION PERIOD**

- A. Completion of Construction Work:
  - 1. Complete the work to bring the Project to a state of substantial completion.
- B. Equipment Start-up:
  - 1. Requirements for individual items of equipment are included in the Technical Specification Sections.
  - 2. Prepare the equipment so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.

3. Perform Equipment Start-up to extent possible without introducing product flow.
  4. Introduce product flow to complete Equipment Start-up for the following equipment:
    - a. Piping
    - b. Valves
    - c. gates
    - d. Manholes.
    - e. Meters
    - f. 20-ft Round tanks.
    - g. Low head oxygenators.
    - h. Weirs.
    - i. Drumfilters
    - j. Pumps.
    - k. Clarifier
    - l. Sludge storage tanks
  5. Procedures include but are not necessarily limited to the following:
    - a. Test or check and correct deficiencies of:
      - 1) Power, control, and monitoring circuits for continuity prior to connection to power source.
      - 2) Voltage of all circuits.
      - 3) Phase sequence.
      - 4) Cleanliness of connecting piping systems.
      - 5) Alignment of connected machinery.
      - 6) Vacuum and pressure of all closed systems.
      - 7) Lubrication.
      - 8) Valve orientation and position status for manual operating mode.
      - 9) Tankage for integrity using project flow.
      - 10) Pumping equipment using product flow.
      - 11) Instrumentation and control signal generation, transmission, reception, and response.
      - 12) Tagging and identification systems.
      - 13) All equipment: Proper connections, alignment, calibration and adjustment.
    - b. Calibrate all safety equipment.
    - c. Manually rotate or move moving parts to assure freedom of movement.
    - d. "Bump" start electric motors to verify proper rotation.
    - e. Perform other tests, checks, and activities required to make the equipment ready for Demonstration Period.
    - f. Documentation:
      - 1) Prepare a log showing each equipment item subject to this paragraph and listing what is to be accomplished during Equipment Start-up.
      - 2) Provide a place for the Contractor to record date and person accomplishing required work.
      - 3) Submit completed document before requesting inspection for Substantial Completion certification.
  6. Obtain certifications, without restrictions or qualifications, and deliver to Engineer:
    - a. Manufacturer's equipment installation check letters (sometimes referred to as Manufacturer's Field Services report).
    - b. Instrumentation Supplier's Instrumentation Installation Certificate.
- C. Personnel Training:
1. See individual equipment specification sections.
  2. Conduct all personnel training after completion of Equipment Start-up for the equipment for which training is being conducted.
    - a. Personnel training on individual equipment or systems will not be considered completed unless:

- 1) All pretraining deliverables are received and approved before commencement of training on the individual equipment or system.
- 2) No system malfunctions occur during training.
- 3) All provisions of field and classroom training specifications are met.
- b. Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to Owner.
3. Field and classroom training requirements:
  - a. Hold classroom training on-site.
  - b. Notify each manufacturer specified for on-site training that the USER or Engineer reserves the right to video record any or all training sessions.
    - 1) Organize each training session in a format compatible with video recording.
  - c. Training instructor qualification: Factory trained and familiar with giving both classroom and "hands-on" instructions.
  - d. Training instructors:
    - 1) Be at classes on time.
    - 2) Session beginning and ending times to be coordinated with the Owner and indicated on the master schedule.
    - 3) Normal time lengths for class periods can vary, but brief rest breaks should be scheduled and taken.
  - e. Organize training sessions into maintenance verses operation topics and identify on schedule.
  - f. Plan for minimum class attendance of 5 people at each session and provide sufficient classroom materials, samples, and handouts for those in attendance.
  - g. Instructors to have a typed agenda and well prepared instructional material.
    - 1) The use of visual aids, e.g., films, pictures, and slides is recommended for use during the classroom training programs.
    - 2) Deliver agendas to the Owner a minimum of seven (7) days prior to the classroom training.
    - 3) Provide equipment required for presentation of films, slides, and other visual aids.
  - h. In the on-site training sessions, cover the information required in the Operation and Maintenance Manuals submitted according to Specification Section 01 33 04 and the following areas as applicable to PCS's.
    - 1) Operation of equipment.
    - 2) Lubrication of equipment.
    - 3) Maintenance and repair of equipment.
    - 4) Troubleshooting of equipment.
    - 5) Preventive maintenance procedures.
    - 6) Adjustments to equipment.
    - 7) Inventory of spare parts.
    - 8) Optimizing equipment performance.
    - 9) Capabilities.
    - 10) Operational safety.
    - 11) Emergency situation response.
    - 12) Takedown procedures (disassembly and assembly).
  - i. Address above Paragraphs 1), 2), 8), 9), 10), and 11) in the operation sessions. Address above Paragraphs 3), 4), 5), 6), 7), and 12) in the maintenance sessions.
  - j. Maintain a log of classroom training provided including: Instructors, topics, dates, time, and attendance.
- D. Complete the filing of all required submittals:
  1. Shop Drawings.
  2. Operation and Maintenance Manuals.
  3. Training material.
- E. Filing of Contractor's Notice of Substantial Completion and Request for Inspection of Project or PCS:



1. File the notice when the following have been completed:
  - a. Construction work (brought to state of Substantial Completion).
  - b. Equipment Start-up.
  - c. Personnel Training.
  - d. Submittal of required documents.
2. Engineer will review required submittals for completeness within 5 calendar days of Contractor's notice. If complete, Owner will complete inspection of the Work, within 10 calendar days of Contractor's notice.
3. Engineer will inform Contractor in writing of the status of the Work reviewed, within 14 calendar days of Contractor's notice.
  - a. Work determined not meeting state of Substantial Completion:
    - 1) Contractor: Correct deficiencies noted or submit plan of action for correction within 5 days of Engineers determination.
    - 2) Engineer: Reinspect work within 14 days of Contractor's notice of correction of deficiencies.
    - 3) Reinspection costs incurred by Engineer will be billed to Owner who will deduct them from final payment due Contractor.
  - b. Work determined to be in state of tentative Substantial Completion: Engineer to prepare tentative "Engineer's Certificate of Substantial Completion."
  - c. Engineer's Certificate of Substantial Completion:
    - 1) Certificate tentatively issued subject to successful Demonstration of functional integrity.
    - 2) Issued for Project as a whole or for one or more PCS.
    - 3) Issued subject to completion or correction of items cited in the certificate (punch list).
    - 4) Issued with responsibilities of Owner and Contractor cited.
    - 5) Executed by Engineer.
    - 6) Accepted by Owner.
    - 7) Accepted by Contractor.
  - d. Upon successful completion of Demonstration Period, Engineer will endorse certificate attesting to the successful demonstration, and citing the hour and date of ending the successful Demonstration Period of functional integrity as the effective date of Substantial Completion.

### **3.3 DEMONSTRATION PERIOD**

- A. General:
  1. Demonstrate the functional integrity of the mechanical, electrical, and control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.
  2. Duration of Demonstration Period: 120 consecutive hours.
  3. If, during the Demonstration Period, the aggregate amount of time used for repair, alteration, or unscheduled adjustments to any equipment or systems that renders the affected equipment or system inoperative exceed 10 percent of the Demonstration Period, the demonstration of functional integrity will be deemed to have failed.
    - a. In the event of failure, a new Demonstration Period will recommence after correction of the cause of failure.
    - b. The new Demonstration Period shall have the same requirements and duration as the Demonstration Period previously conducted.
  4. Conduct the demonstration of functional integrity under full operational conditions.
  5. Owner will provide operational personnel to provide process decisions affecting plant performance.
    - a. Owner's assistance will be available only for process decisions.
    - b. Contractor will perform all other functions including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period.

6. Owner reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, etc., to verify the functional integrity of automatic and manual backup systems and alternate operating modes.
7. Time of beginning and ending any Demonstration Period shall be agreed upon by Contractor, Owner, and Engineer in advance of initiating Demonstration Period.
8. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's questions, provide final field instruction on select systems and to respond to any system problems or failures which may occur.
  - a. Provide final field instruction.
9. Provide all labor, supervision, utilities, chemicals, maintenance, equipment, vehicles or any other item necessary to operate and demonstrate all systems being demonstrated.

**END OF SECTION**

**SECTION 01 77 00**  
**CONTRACT CLOSEOUT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Specific requirements for the closeout procedures for the project.

**1.2 SUBMITTALS**

- A. Contract Closeout Information:
1. For substantial completion:
    - a. Comprehensive list of all items to be completed or corrected.
    - b. Contractor's Notice of Substantial Completion.
    - c. Certificates of governing authorities.
    - d. Submittals required by other Sections.
  2. For final completion:
    - a. Contractor's Certificate of Completion.
    - b. Evidence of payments and release or waiver of liens in triplicate.
      - 1) Contractor's Affidavit of Payments of Debts and Claims.
      - 2) Contractor's Affidavit of Release of Liens.
      - 3) Contractor's release or waiver of liens.
      - 4) Separate releases or waivers of liens for subcontractors, suppliers, and others with lien rights against Owner, together with list of all such parties.
      - 5) If required by Owner, other data establishing payment or satisfaction of obligations arising out of Contract.
    - c. Consent of Surety (if any) to Final Payment.
    - d. Certificates evidencing that insurance to remain enforce.
    - e. Final application for payment.
    - f. Initialed list(s) of items to be completed or corrected verifying completion of each items.
    - g. List of Subcontractors and equipment suppliers. Include:
      - 1) Name.
      - 2) Address.
      - 3) Telephone number.
      - 4) Representative.
    - h. Letter of site conformance.
    - i. Closeout submittals required by other Sections.

**1.3 SUBSTANTIAL COMPLETION**

- A. Substantial Completion is the stage in the progress of Work when the Work or designated portion thereof is sufficiently complete in general accordance with Contract Documents so USER can occupy or utilize Work for its intended use.
1. Work will not be considered for Substantial Completion until all systems and equipment are operational; all designated or required governing agency inspections and certifications have been made and posted, instruction of designated USER's personnel in operation of systems and equipment has been completed, operation and maintenance data has been satisfactorily turned over to USER, and finishes are in place. In general, the only remaining Work shall be minor in nature, such that USER may occupy or utilize Work or designated portion thereof, and completion or correction of Work by Contractor would not materially interfere or hamper USER's intended business use or operation.
  2. Contractor shall certify that all remaining Work will be completed within 30 consecutive calendar days following date of Substantial Completion, or as agreed to in writing, and

failure to do so shall automatically reinstate provisions for damages due Owner as contained elsewhere in Contract Document or as provided by law for such period of time as may be required by Contractor to fully complete Work whether USER has occupied Work or not.

- B. Obtain evidence of compliance with requirements of governing authorities:
  - 1. Certificates of inspection of:
    - a. Mechanical.
    - b. Electrical.
    - c. Plumbing.
    - d. Fire protection and life safety systems.
    - e. Etc.
  - 2. Health Department and other governing authorities as required.
  - 3. Certificate of Occupancy.
- C. When Contractor considers that Work, or a portion thereof which OWNER agrees to accept separately, is substantially complete, Contractor shall thoroughly inspect Work, and prepare and submit to OWNER a comprehensive list of items to be corrected or completed, and Contractor's Notice of Substantial Completion (utilize form at end of this Section).
- D. Contractor certify that:
  - 1. Work performed under this Contract has been thoroughly inspected and considered to be sufficiently complete, in accordance with Contract Documents, so USER can occupy or utilize Work for its intended use.
- E. Failure of Contractor to include an item on such list(s) does not alter responsibility of Contractor to complete all Work in accordance with Contract Documents.
- F. Contractor shall proceed promptly to complete and correct the items on list.
- G. After receipt of Contractor's comprehensive list of items to be corrected or completed, and Contractor's Notice of Substantial Completion, OWNER will, within reasonable period after notification, review list of items to be completed or corrected, or inspect Work, or designated portion thereof, to determine whether Work is Substantially Complete.
- H. If Architect/Engineer's or OWNER's review or inspection discloses any item, whether or not included on Contractor's list, which is not sufficiently complete in general accordance with Contract Documents so USER can occupy or utilize Work or designated portion thereof for its intended use:
  - 1. Contractor will be notified stating reasons.
  - 2. Contractor shall substantially complete or correct Work.
  - 3. Contractor shall thoroughly re-inspect Work.
  - 4. Contractor shall submit another Contractor's Notice of Substantial Completion, a revised list of items to be completed or corrected, and a request for another review.
  - 5. Architect/Engineer and OWNER will again review list of items to be completed or corrected and Work.
- I. If Contractor prematurely submits a Contractor's Notice of Substantial Completion or requests Architect/Engineer's review of Work, and Architect/Engineer determines that Project or designated portion thereof is not Substantially Complete, Architect/Engineer may invoice Owner as a change in services for such cost involved in evaluating and reviewing Work, and associated travel costs. Contractor shall reimburse Owner for such costs.
- J. Architect/Engineer will not perform more reviews of sub-projects or phases than number indicated in Contract Documents or Owner – Architect/Engineer Agreement, unless otherwise mutually agreed to by Architect/Engineer and Owner.
- K. When Work or designated portion thereof is considered Substantially Complete, OWNER will prepare a Certificate of Substantial Completion.
  - 1. The Certificate of Substantial Completion shall establish date of Substantial Completion, shall establish responsibilities of Owner and Contractor for security, maintenance, heat,

- utilities, damage to Work and insurance, and shall fix time within which Contractor shall complete and correct Work.
2. Warranties and guarantees required by Contract Documents shall commence on date of Substantial Completion of Work or designated portion thereof unless otherwise provided in Certificate of Substantial Completion.
  3. The Certificate of Substantial Completion shall be submitted to Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.
- L. USER may occupy Project, or designated portion thereof, under provisions agreed to in Certificate of Substantial Completion, and if required, a certificate of occupancy has been issued by governing authorities.
1. If USER is going to occupy Project, or designated portion thereof, Contractor shall perform final cleaning immediately.
  2. If OWNER or Architect/Engineer discovers any Work which is not complete and/or is not in conformance with Contract Documents, during or after occupying or utilizes Work, whether included on a list or not, OWNER shall notify Contractor to complete or correct item(s) identified.
- M. Contractor shall proceed expeditiously with adequate forces to complete or correct Work, and to complete all Project closeout requirements within designated time.
- N. Upon completion of Work, employ Licensed Surveyor to make survey of site to assure conformance of elevations, grade and site work to contours shown. Provide letter of site conformance.

#### **1.4 FINAL COMPLETION**

- A. After Contractor has completed all Work, and has thoroughly inspected Work to determine that it is sufficiently complete, is in general accordance with Contract Documents, and Contract is fully performed, Contractor shall submit Contractor's Certificate of Completion to OWNER (DGS Form CO-13.2), and the list(s) of items to be completed or corrected initialed to indicate Contractor has verified completion of each item. Utilize form at end of this section. Contractor certifies that:
1. Work has been thoroughly inspected by Contractor for compliance with Contract Documents.
  2. Work has been completed in accordance with Contract Documents.
  3. Equipment and systems have been tested and are operating satisfactorily.
  4. Contract closeout requirements have been completed satisfactorily and submitted.
  5. Contractor knows of no reason that insurance will not be renewable to cover period required by Contract Documents.
  6. Work is ready for final inspection and acceptance.
- B. Contractor submit final closeout submittals required by this and other Sections.
- C. OWNER and Architect/Engineer will make final walk through within a reasonable time after receipt of Contractor's Certificate of Completion and final Application for Payment.
1. If Contractor prematurely submits a Contractor's Notice of Final Completion or requests Architect/Engineer's final review of Project, and Architect/Engineer determines that Project is not satisfactorily complete, Architect/Engineer may invoice Owner as a change in services for such cost involved in evaluating and reviewing Work, and associated travel costs. Contractor shall reimburse Owner for such costs.
- D. Contractor shall remedy any remaining deficiencies or incomplete Work, at Contractor's expense.
- E. When OWNER and Architect/Engineer finds Work acceptable under Contract Documents and Contract satisfactorily performed, Architect/Engineer will submit Certificate of Completion (DSG Form CO-13.1). OWNER will promptly issue a final Certificate for Payment.

- F. Neither final payment nor any remaining retained percentage shall become due until Contractor submits to OWNER;
1. an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with Work for which Owner or USER's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied,
  2. a certificate evidencing that insurance required by Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to OWNER,
  3. a written statement that Contractor knows of no substantial reason that insurance will not be renewable to cover period required by Contract Documents,
  4. consent of surety, if any, to final payment,
  5. Contractor's and Subcontractor's final release or waiver of liens,
  6. if required by OWNER, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of Contract, to extent and in such form as may be designated by OWNER, for OWNER's review, and
  7. if a Subcontractor refuses to furnish a release or waiver required by OWNER, Contractor may furnish a bond satisfactory to OWNER to indemnify Owner against such lien. If such lien remains Owner after payments are made, the Contractor shall refund to Owner all money that Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.
- G. If Substantial Completion or Final Completion is delayed through no fault of Owner or Architect/Engineer, Architect/Engineer may invoice Owner as a change in services for such costs, and associated travel costs. Contractor shall reimburse Owner for such costs.

#### **END OF SECTION**

## CONTRACTOR'S NOTICE OF SUBSTANTIAL COMPLETION

PROJECT: \_\_\_\_\_

ARCH PROJ. NO.: \_\_\_\_\_ CONTRACT DATE: \_\_\_\_\_

CONTRACT FOR: \_\_\_\_\_

WORK OR DESIGNATED PORTION SHALL INCLUDE: \_\_\_\_\_

Work performed under this Contract has been thoroughly inspected and is considered to be sufficiently complete, in accordance with Contract Documents, so USER can occupy or utilize Work or designated portion thereof for its intended use.

- ☐ Certificates of inspections indicating compliance with requirements of governing authorities, are attached hereto.
- ☐ Certificate of Occupancy have been obtained from governing authorities, are attached hereto.
- ☐ A comprehensive list of items to be completed or corrected, prepared by Contractor is attached, hereto. Failure to include any items on such list does not alter responsibility of Contractor to complete all Work in accordance with Contract Documents.

Contractor will complete or correct Work by: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

BY: \_\_\_\_\_ DATE: \_\_\_\_\_

OWNER (agrees) (does not agree) to accept portion designated above separately from rest of Project.

USER intends to utilize, occupy or take use on: \_\_\_\_\_

OWNER: \_\_\_\_\_

BY: \_\_\_\_\_ DATE: \_\_\_\_\_

The Work designated above, has been determined to be:

- ☐ Substantially Complete and a Certificate of Substantial Completion will be issued.
- ☐ Not substantially complete for following reasons: \_\_\_\_\_

ARCHITECT: HDR Engineering, Inc.

BY: \_\_\_\_\_ DATE: \_\_\_\_\_

DISTRIBUTION: ☐ OWNER ☐ ARCHITECT/ENGINEER ☐ CONTRACTOR

## END OF CONTRACTOR'S NOTICE OF SUBSTANTIAL COMPLETION

## CONTRACTOR'S CERTIFICATE OF COMPLETION

PROJECT: \_\_\_\_\_

ARCH. PROJECT \_\_\_\_\_

NUMBER: \_\_\_\_\_

CONTRACT FOR: \_\_\_\_\_

CONTRACT DATE: \_\_\_\_\_

This is to certify that I am an authorized official of, and have been properly authorized by said firm or corporation to certify following:

I know of my own personal knowledge, and do hereby certify on behalf of Contractor,  
that Work has been reviewed and thoroughly inspected for compliance with Contract Documents,  
that Work has been completed, in accordance with Contract Documents and Contract is fully performed,  
that all equipment and systems have been tested and are operating satisfactorily,  
that all Contract closeout requirements have been completed satisfactorily and submitted,  
know of no substantial reason that insurance will not be renewable to cover period required by Contract Documents, and Work is ready for final inspection and acceptance.

Attached are three (3) copies of following documents, which are required prior to final payment:

- ☐ Final Application for Payment.
- ☐ Contractor's Affidavit of Payments of Debts and Claims
- ☐ Contractor's Affidavit of Release of Liens:
- ☐ Contractor's Final Release or Waiver of Liens.
- ☐ Consent of Surety (if any) to Final Payment:
- ☐ Certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least thirty (30) days' prior written notice has been given to OWNER.
- ☐ The list(s) of if items which were to be completed and corrected, with each item initialed to indicate Contractor has verified completion or correction of each.
- ☐ List of subcontractors and equipment suppliers.
- ☐ Certified list of all sales and service taxes paid.
- ☐ Letter of site conformance by licensed surveyor.
- ☐ If required by OWNER, other data establishing payment or satisfaction of obligations arising out of Contract.
- ☐ Bond satisfactory to OWNER to indemnify OWNER against liens from Subcontractors.
- ☐ Transmittal indicating OWNER has received Project Record Documents.

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

CONTRACTOR: \_\_\_\_\_ BY: \_\_\_\_\_

TITLE: \_\_\_\_\_ DATE: \_\_\_\_\_

Subscribed and sworn to me this \_\_\_\_\_ day of \_\_\_\_\_

NOTARY PUBLIC: \_\_\_\_\_

My commission expires: \_\_\_\_\_

DISTRIBUTION: ☐ OWNER ☐ ARCHITECT/ENGR



## END OF CONTRACTOR'S CERTIFICATE OF COMPLETION

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**SECTION 01 78 23**  
**OPERATION AND MAINTENANCE DATA**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Requirements for Contractor-furnished, manufacturers' operation and maintenance (O&M) data, including:
    - a. Required operation and maintenance data groupings into operation and data manuals and timing of such Submittals.
    - b. Requirements for paper copies of operation and maintenance data and related Electronic Documents.
    - c. Content of operation and maintenance data Submittals.
- B. Scope:
  - 1. Contractor shall submit operation and maintenance data, and related information, in accordance with this Section and requirements elsewhere in the Contract Documents, as instructional and reference information for use by: (a) Owner's operation and maintenance personnel, and (b) others retained by or working for Owner.
  - 2. In addition to operation and maintenance data expressly required elsewhere in the Contract Documents, also submit operation and maintenance data for:
    - a. All equipment and systems, including facility equipment, plumbing equipment, HVAC equipment, electrical equipment, communications equipment, electronic safety and security systems, utility equipment, process equipment, and other equipment.
    - b. Valves, gates, actuators, and related accessories.
    - c. Instrumentation and control devices and systems.
    - d. Building materials, systems, and finishes that need post-construction troubleshooting, cleaning, or maintenance, such as roofing, doors, windows, louvers, flooring, paint and coatings, other finishes, and other items.
- C. Related Requirements:
  - 1. Section 01 33 00 - Submittal Procedures.
  - 2. Section 01 75 00 - Checkout and Startup Procedures.
  - 3. Section 01 78 36 - Warranties.

**1.2 SUBMITTALS**

- A. Closeout Submittals: Submit the following:
  - 1. Operation and Maintenance Data:
    - a. Submit operation and maintenance data, required by the Contract Documents, grouped into operation and maintenance manual Submittals indicated in Table 01 78 23-A.
    - b. Where operation and maintenance data required by the Contract Documents, is not expressly indicated in table 01 78 23-A, obtain written clarification or interpretation from Engineer prior to preparing and transmitting such Submittal.
    - c. For each required operation and maintenance manual Submittal, furnish preliminary Submittal and final Submittal. Timing of preliminary and final operation and maintenance manual Submittals, and differences between preliminary and final Submittals, are indicated in this Section.

**Table 01 78 23-A**  
**Required Groupings of Operation and Maintenance Data Submittals**

Name of O&M Manual/Data	For Materials or Equipment Specified in Section(s)

**B. Timing of Submittals and Quantity Required:**

1. Preliminary Operation and Maintenance Manual Submittals:
  - a. Paper Copies: Three copies, exclusive of copies required for Contractor's use.
  - b. Electronic Documents: As required by Owner in a mutually agreeable format.
  - c. Submit to entity indicated in Section 01 33 00 – Submittal Procedures, by the earlier of: 90 days following approval of Shop Drawings and product data Submittals, or 14 days prior to starting training of operation and maintenance personnel, or 14 days prior to field quality control testing at the Site.
  - d. Do not perform checkout, startup, and training without Engineer's acceptance of preliminary operation and maintenance data Submittals for the associated Work.
2. Final Operation and Maintenance Manual Submittals: Furnish final Submittal prior to Substantial Completion of the associated Work, unless submittal is required prior to an interim Milestone.
  - a. Paper Copies: Three copies, exclusive of copies required for Contractor's use.
  - b. Electronic Documents: As required by Owner in a mutually agreeable format.
  - c. Work will not be eligible for Substantial Completion until associated, required final operation and maintenance data Submittals are accepted by Engineer.
  - d. If Contractor (whether or not via Subcontractor or Supplier), revises program code or configuration files between acceptance of Submittal by Engineer and end of the Contract's correction period and Contractor's general warranty obligation, furnish updated program code and configuration files to Owner. Before modifying program code and configuration files after Substantial Completion, verify with facility manager that Owner- or facility manager modifications of program code or configuration files were incorporated into the modified files, subject to the provisions of this Section.

### **1.3 PAPER COPIES OF O&M MANUALS**

**A. Binding and Cover:**

1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy, as necessary.
2. Binders shall be not less than one inch wide and maximum of three inches wide. Binders for each copy of each volume shall be same size and color.
3. Binders shall be locking three-ring ("D"-ring) type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front and back of each volume.
4. Do not overfill binders.
5. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
6. Indicate the following information on cover of each volume:
  - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS". For submittal of preliminary operation and maintenance data, include the word, "PRELIMINARY" in the title.
  - b. Name or type of material or equipment covered in the manual.

- c. Volume number, if more than one volume is submitted, listed as “Volume #of #”, with appropriate volume-designating numbers filled in.
  - d. Name of Project and, when applicable, Contract name and number.
  - e. Name of building or structure, as applicable.
- 7. Provide the following information on spine of each volume:
  - a. Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”. For submittal of preliminary operation and maintenance data, include the word, “PRELIMINARY” in the title.
  - b. Name or type of material or equipment covered in the manual.
  - c. Volume number, when more than one volume is submitted, listed as “Volume #of #”, with appropriate volume-designating numbers filled in.
  - d. Project name and building or structure name.
- B. Pages:
  - 1. Print pages in paper copies of operation and maintenance manuals on 30-pound (minimum) paper, 8.5-inch by 11-inch size.
  - 2. Reinforce binding holes in each individual paper sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of manuals, reinforcing of pages within booklet or pamphlet is not required.
  - 3. Furnish each page with binding margin not less than 3/4-inch wide.
  - 4. Properly punch each paper page with holes suitable for associated binding. Provide not less than 3/8-inch of paper between outer edge of punched holes and edge of paper. Manuals with improperly punched holes will be returned to Contractor as unacceptable.
  - 5. In paper copies of manuals, each page in each copy shall be properly bound-through by the binder’s rings or posts. Paper manuals where some pages are not so bound will be returned to Contractor as unacceptable.
- C. Drawings:
  - 1. Bind into operation and maintenance manuals drawings, diagrams, and illustrations up to and including 11-inch by 17-inch size, with reinforcing and punched holes specified for paper pages.
  - 2. Drawings or sheets larger than 11-inch by 17-inch shall be:
    - a. Paper Copies: Neatly folded and inserted into clear plastic pockets bound into the manual. Neatly and permanently label each pocket with printed text indicating content and drawing numbers. Include not more than two drawings or sheets per pocket.
    - b. Electronic Documents Copies: Included in electronic file at appropriate location.
- D. Copy Quality and Document Clarity:
  - 1. Provide original-quality copies. Documents in operation and maintenance manuals shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals with copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable.
  - 2. Clearly mark, using ink, to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished and cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.
- E. Organization:
  - 1. Indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

#### **1.4 ELECTRONIC DOCUMENTS O&M MANUALS**

- A. Electronic Documents of Operation and Maintenance Manuals:
  - 1. Each Electronic Document copy of operation and maintenance data shall include all information included in the corresponding paper copy.

2. Submit Electronic Documents operation and maintenance data in as required by Owner in a mutually agreeable format, and Section 01 33 00 - Submittal Procedures.
3. File Format:
  - a. Unless otherwise required by Owner in a mutually agreeable format, or Section 01 33 00 - Submittal Procedures, operation and maintenance data Electronic Documents shall be "portable document format" (PDF) files.
  - b. Electronic Documents shall be electronically searchable upon delivery.
  - c. Electronic Documents shall not be password-protected and shall not be protected against Owner's or facility manager's copying and printing such files for Owner's or facility manager's use in operating and maintaining the facility.
  - d. Electronic Documents shall open to its first page.
  - e. Submit each operation and maintenance manual as a single Electronic Document file, unless file size is over-large, in which case divide into as few separate files, each with similar filename, as possible.
  - f. Within each Electronic Document, provide bookmarks for the following:
    - 1) Each chapter and subsection indicated in the corresponding printed copy document's table of contents.
    - 2) Each figure.
    - 3) Each table.
    - 4) Each appendix and attachment.

## 1.5 CONTENT OF OPERATION AND MAINTENANCE MANUALS

- A. Operation and Maintenance Manual Content – General:
  1. Prepare each operation and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-constructed drawings as applicable, bills of materials, technical information, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
  2. Provisions of this Article were written for equipment. Where operation and maintenance data are required for building products, such as finishes, openings, thermal and moisture protection, and similar items, comply with this Article to the extent practical and reasonable for the associated item.
  3. Completeness and Accuracy:
    - a. Operation and maintenance manuals that include language stating or implying that the manual's content may be insufficient or stating that the manual's content is not guaranteed to be complete and accurate are unacceptable.
    - b. Operation and maintenance manuals shall be complete and accurate.
    - c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.
  4. Provide dividers and Include manufacturer's information, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where published documents, included in operation and maintenance data, pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.
  5. Identify each equipment item consistent with names and identification numbers shown or indicated in the Contract Documents, rather than manufacturer's model numbers.
  6. Neatly type data not furnished in computer-printed text. Handwriting, except for strikeouts, arrows, and the like, is unacceptable.

7. Include copy of warranty in accordance with the Contract Documents, including Section 01 78 36 - Warranties.
  8. Include copy of proposed service contract, when applicable.
  9. When copyrighted material is used in operation and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.
- B. Differences Between Preliminary and Final Operation and Maintenance Manuals:
1. In preliminary operation and maintenance manuals, include flysheet or placeholder for information to be included in final operation and maintenance manual Submittal.
  2. In final operation and maintenance manuals, include information such as the following, as applicable for the associated materials and equipment:
    - a. Equipment data that requires collection after startup, for example: (1) system and equipment balancing reports, including those for HVAC systems; and (2) final settings for electrical switchgear, automatic transfer switches, and circuit breakers; and (3) materials and equipment field testing results.
    - b. Equipment startup reports and Suppliers' field service reports (the latter on form in Section 01 75 00 - Checkout and Startup Procedures).
- C. Initial Documents in Operation and Maintenance Manuals:
1. Table of Contents:
    - a. Provide table of contents in each volume of each operation and maintenance manual.
    - b. In table of contents and not less than once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identifying items is unacceptable.
  2. Equipment Record:
    - a. Provide "Equipment Record" section of operation and maintenance manual immediately following the table of contents. "Equipment Record" section is not required for operation and maintenance data for other than equipment (such as building materials and finishes).
    - b. Provide "Equipment Record" on forms included as this Section's Attachments 1, 2, and 3.
    - c. For instrumentation and control equipment, International Society of Automation (ISA) data sheets are acceptable in lieu of the forms included as this Section's Attachments 1, 2, and 3.
    - d. This Section's Attachments 1, 2, and 3 are available from Engineer as "fillable PDF forms".
    - e. Complete in detail each section of "Equipment Record". Merely referencing the associated equipment's operation and maintenance data for nameplate, maintenance, spare parts, lubricants, or other required information, is unacceptable.
    - f. For equipment or systems with multiple, separate components (for example, motor and gearbox), fully completed "Equipment Record" is required for each component.
    - g. Operation and maintenance data Submittals without complete and accurate "Equipment Record" sheets are unacceptable.
  3. Supplier's Field Service Reports:
    - a. Include in final operation and maintenance manuals copies of associated Supplier's field services reports in accordance with Section 01 75 00 - Checkout and Startup Procedures.
    - b. Include Supplier's completed field service reports in operation and maintenance manual in section immediately following "Equipment Record" section.
- D. Operation and Maintenance Instructions:
1. Safety Considerations:

- a. Submit written descriptions of safety considerations relating to operation and maintenance procedures for materials and equipment.
  - b. Describe safety devices and alarms provided with materials and equipment and proper operation and use.
  - c. Indicate procedures for proper, safe operating and maintenance of materials and equipment furnished, including manufacturer's recommended personal protection equipment, apparatus, and devices not furnished under the Contract.
  - d. Describe recommended safety-related training for personnel operating and maintaining the subject materials or equipment.
  - e. Include in appendix to operation and maintenance manual manufacturers' relevant "safety data sheets" (SDS), formerly "material safety data sheets" (MSDS).
  - f. Engineer's review of operation and maintenance data expressly does not extend to adequacy, completeness, and accuracy of SDS or other safety and protection practices and procedures indicated in the operation and maintenance data.
2. Operation:
    - a. Include in operation and maintenance data Submittals complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; and regulation and control. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.
    - b. Include pre-startup instructions and checklists and complete startup instructions for each material and equipment item.
    - c. Indicate recommended operating instructions for all operating modes and conditions, with associated recommendations for safe operation.
    - d. Explain available controls and instrumentation and associated function(s).
    - e. Indicate required shutdown checklists and procedures for: normal shutdown, emergency shutdown, and long-term shutdowns.
    - f. Troubleshooting instructions.
  3. Maintenance – General:
    - a. Include in operation and maintenance data complete, written instructions for necessary and recommended maintenance, including mechanical maintenance and electrical/instrumentation and controls maintenance, as applicable.
    - b. Include in operation and maintenance data complete instructions for necessary assembly, disassembly, installation, re-installation, storage, and shipping for materials and equipment.
    - c. Tools: Include list of required maintenance tools and equipment.
    - d. Spare Parts and Extra Materials:
      - 1) Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.
      - 2) Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.
      - 3) Also refer to this Article's provision, "Bills of Materials", below, for additional requirements regarding ordering replacement parts.
  4. Routine and Preventative Maintenance:
    - a. Submit complete, detailed, written instructions for routine and preventive maintenance including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:



- 1) Written explanations with illustrations for each routine and preventive maintenance task such as inspection, adjustment, anchor bolt torque checks, lubrication, calibration, cleaning, replacement of filters, and the like.
  - 2) Recommended schedule for each routine and preventive maintenance task.
  - 3) Lubricants:
    - a) Provide lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
    - b) Table of alternative lubricants.
  5. Major Maintenance:
    - a. Include detailed, written instructions and illustrations for required periodic (non-routine, non-preventative) maintenance.
    - b. Indicate relative level of training and expertise required to perform such maintenance and recommended tools and equipment.
  6. Special Maintenance:
    - a. Include maintenance instructions for long-term shutdowns and storage.
- E. Bills of Materials:
1. Include in operation and maintenance manuals complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
  2. Manufacturer's name, physical address, telephone number, internet website address.
  3. Manufacturer's local service representative's or local parts supplier's name, physical address, telephone number, internet website address, and e-mail addresses.
  4. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
  5. For each part or piece include the following information:
    - a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
    - b. Part name or description.
    - c. Manufacturer's part number.
    - d. Quantity of each part used in each assembly.
    - e. Current unit price of the part at the time the operation and maintenance manual is submitted. Price list shall be dated.
- F. Record Copy of Shop Drawings, Product data, and Other Previously Approved and Accepted Submittals:
1. Submit original-quality copies of each approved and accepted (as applicable) Shop Drawing, product data Submittal, written results of source quality control activities, and other Submittals, updated to indicate as-installed condition. Do not include prior Submittals that were not approved or were not accepted. Reduced drawings are acceptable only when reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.
- G. Electrical Schematics, Diagrams, and Information:
1. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
  2. Include as-constructed drawings of layouts of electrical panels (such as switchgear and motor control centers) and control panels.
- H. NFPA 70 (National Electric Code) Documentation:
1. Include in operation and maintenance manuals for electrically-powered equipment documented calculations of: (1) arc-fault current, equipment available fault current and (2) short-circuit current rating (SCCR), provided as part of equipment Submittals.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 ATTACHMENTS**

- A. The following, bound after this Section's "End of Section" designation, are part of this Section:
  - 1. Attachment 1 - Equipment Data and Spare Parts Summary form (one page)
  - 2. Attachment 2 - Recommended Maintenance Summary form (one page)
  - 3. Attachment 3 - Lubrication Summary form (one page)

**END OF SECTION**





## ATTACHMENT 1

## Equipment Record

## Equipment Data and Spare Parts Summary

Project Name					Specification Section:				
Equipment Name					Year Installed:				
Project Equipment Tag No(s).									
Equipment Manufacturer					Project/Order No.				
Address					Phone				
Website			Web Site			E-mail			
Local Representative/Service Center									
Address					Phone				
Website					E-mail				
<b>MECHANICAL NAMEPLATE DATA</b>									
Equip.					Serial No.				
Make					Model No.				
ID No.		Frame No.		HP		RPM		Cap.	
Size		TDH		Imp. Size		CFM		PSI	
Other:									
<b>ELECTRICAL NAMEPLATE DATA</b>									
Equip.					Serial No.				
Make					Model No.				
ID No.	Frame No.	HP	V.	Amp.	Hertz	PH	RPM	SF	
Duty	Code	Ins. Cl.	Type	NEMA	C Amb.	Temp. Rise	Rating		
Other:									
<b>SPARE PARTS PROVIDED PER CONTRACT</b>									
Part No.		Part Name							Quantity
<b>RECOMMENDED SPARE PARTS</b>									
Part No.		Part Name							Quantity

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## Recommended Maintenance Summary

Equipment Description	Project Equip. Tag No(s).								
RECOMMENDED BREAK-IN MAINTENANCE (FIRST OIL CHANGES, ETC.)	INITIAL COMPLETION * FOLLOWING START-UP								
	D	W	M	Q	S	A	RT	Hours	
RECOMMENDED PREVENTIVE MAINTENANCE	PM TASK INTERVAL *								
	D	W	M	Q	S	A	RT	Hours	

\* D = Daily    W = Weekly    M = Monthly    Q = Quarterly    S = Semiannual    A = Annual    Hours = Run Time Interval

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## ATTACHMENT 3

## Equipment Record

## Lubrication Summary

Equipment Description	Project Equip. Tag No(s).
-----------------------	---------------------------

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

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## **SECTION 01 78 36**

### **WARRANTIES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. General requirements for warranties required in the various Specifications.
  - 2. Provisions addressing:
    - a. Suppliers' standard warranties.
    - b. Suppliers' special or extended warranties.
    - c. Implied warranties.
    - d. Commencement and duration of warranties.

##### **1.2 SUBMITTALS**

- A. General:
  - 1. For each item of equipment furnished under the Contract, submit Supplier's standard warranty, regardless of whether such warranty or Submittal thereof is required by the associated Specifications for that item. Submit such warranties for materials where such Submittal is required in the Specifications for the material.
  - 2. For each item of material or equipment where Supplier's special (or extended) warranty is required by the Contract Documents, submit appropriate special warranty that complies with the Contract Documents.
  - 3. Supplier's warranties shall be specifically endorsed to Owner, Contractor, and the entity purchasing the item (if other than Contractor) by the entity issuing such warranty.
  - 4. Submit Suppliers' standard warranties and special warranties as Submittals in accordance with the Schedule of Submittals accepted by Engineer.

##### **1.3 CONTRACTOR'S GENERAL WARRANTY AND CORRECTION PERIOD OBLIGATIONS**

- A. Contractor's General Warranty and Guarantee: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.
- B. Contractor's Warranty of Title: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.
- C. Correction Period: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

##### **1.4 SUPPLIERS' WARRANTIES FOR MATERIALS AND EQUIPMENT**

- A. Warranty Types:
  - 1. Required by the General Conditions:
    - a. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, Contractor's general warranty and guarantee and requirements for the Contract's correction period.
    - b. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty and guarantee, nor does such affect or limit Contractor's performance obligations under the correction period.
  - 2. Material or equipment manufacturer's standard warranty is pre-printed, written warranty published by item's manufacturer and specifically endorsed by manufacturer to the entities indicated in this Specifications Section's Article 1.2.
  - 3. Special warranty is written warranty that either extends the duration of material or equipment manufacturer's standard warranty or provides other, increased rights to Owner and other beneficiaries (if any) of such warranty. Where the Contract Documents indicate

specific requirements for warranties that differ from the manufacturer's standard warranty for that item, special warranty is implied.

**B. Requirements for Special Warranties:**

1. Submit written special warranty document that contains appropriate provisions and identification, ready for signature by material or equipment manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section. Submit draft warranty with Submittals required prior to fabrication and shipment of the item from the Supplier's facility.
2. Manufacturer's Standard Form: Modified to include Project-specific information and properly signed by product manufacturer and other entities as appropriate.
3. Specified Form: When specified forms for special warranties are included in the Contract Documents, prepare written document, properly signed by item manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section, using the required form.
4. Refer to the Specifications for content and requirements for submitting special warranties.

## **1.5 IMPLIED WARRANTIES**

**A. Warranty of Title and Intellectual Property Rights:**

1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
2. Provisions on intellectual property rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.

**B. Warranty of Merchantability:**

1. Notwithstanding any other provision of the Contract to the contrary, implied warranties of merchantability required by Laws and Regulations apply to the materials and equipment incorporated into the Work.

**C. Warranty of Fitness-for-Purpose:**

1. Implied warranty of fitness-for-purpose for materials and equipment to be incorporated into the Work, for which specific material or features are indicated in the Contract Documents, is hereby disclaimed by Owner and Contractor.
2. When Supplier is aware of, or has reason to be aware of, specified materials or features of the Work that are contrary to the intended use, purpose, service, application, or environment in which the material or item will be used, submit request for interpretation in accordance with Section 00 72 13. Where appropriate, such request for interpretation shall indicate the apparent discrepancy and propose appropriate, alternative materials or equipment.

## **1.6 COMMENCEMENT AND DURATION OF WARRANTIES**

**A. Commencement of Warranties:**

1. Contract correction period and Contractor's general warranty commence as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
2. Suppliers' standard warranties and special warranties commence running on the date that the associated item is certified by Engineer as substantially complete in accordance with the Contract Documents. In no event shall special warranties commence running prior to Engineer's review and acceptance of special warranty Submittal for the item.
3. Implied warranties commence in accordance with Laws and Regulations.

**B. Duration of Warranties:**

1. Duration of correction period is set forth in the General Conditions, as may be modified by the Supplementary Conditions.
2. Duration of Contractor's general warranty and guarantee is in accordance with Laws and Regulations.
3. Duration of Suppliers' standard warranties is in accordance with the applicable standard warranty document accepted for the Project by Engineer.



4. Duration of required Suppliers' special warranties shall be in accordance with the requirements of the Contract Documents for the subject item.
5. Duration of implied warranties shall be in accordance with Laws and Regulations.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION - (NOT USED)**

**END OF SECTION**

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**SECTION 01 78 39**  
**PROJECT RECORD DOCUMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. All documents required by Contract Documents, including but not limited to:
  - 1. Contract Drawings.
  - 2. Project Manual and Specifications.
  - 3. Addenda.
  - 4. Shop Drawings.
  - 5. Product Data.
  - 6. Samples and Mock-ups.
  - 7. Project Information.
  - 8. Change documents.
  - 9. Request for Information responses, directives, clarifications, interpretations, etc.
  - 10. Field test records.
  - 11. Warranties.
- B. Field Documents:
  - 1. Complete set of all documents required for construction.
  - 2. Used for construction of project.
- C. Periodic Update Documents:
  - 1. Complete separate set of all documents required for construction, with exception of samples and mock-ups, used for posting and updating on weekly basis.
  - 2. Do not use for construction of project.
- D. Project Record Documents:
  - 1. Complete set of all documents required for construction, with exception of samples and mock-ups, for updating at end of Project.

**1.2 SUBMITTALS**

- A. Contract Closeout Information:
  - 1. Copy of transmittal letter to Engineer.
    - a. At completion of project, turn over Project Record Documents to Engineer with letter of transmittal.
    - b. Submit Record Documents in suitable containers .
    - c. Provide Transmittal Letter containing:
      - 1) Date.
      - 2) Project title.
      - 3) Contractor's name and address.
      - 4) Title and number of each Project Record Document.
      - 5) Certification that Project Record Documents submitted are complete, accurate and reflect actual construction of project.
      - 6) Engineer's signature indicating receipt and acceptance of Project Record Documents.
  - 2. Electronic copy of Record Drawing files to Engineer.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

## **PART 3 - EXECUTION**

### **3.1 POSTING PRIOR TO CONSTRUCTION**

- A. After Contract is executed, but prior to start of construction, obtain Contract Drawings and Project Manual/Specifications that will be used for Field Documents and Periodic Update Documents.
- B. Obtain copies of all addenda and post to all above documents.

**END OF SECTION**

**SECTION 01 78 43**  
**SPARE PARTS, TOOLS AND MAINTENANCE MATERIALS**

**PART 1 - GENERAL**

**1.1 SUBMITTALS**

- A. Contract Closeout Information:
  - 1. Submit spare parts, tools and materials directly to USER.
  - 2. Submittal to Engineer is not required.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Spare Parts and Tools:
  - 1. Package in clearly identified boxes.
  - 2. Indicate manufacturer's name, part name and stock number.
  - 3. Indicate piece of equipment part or tool is for.
  - 4. Indicate name, address and phone number of closest supplier.
- B. Maintenance Materials:
  - 1. Package in clearly identified boxes.
  - 2. Indicate trade name and stock number.
  - 3. Indicate which item material is to be used with.
  - 4. Indicate name, address and phone number of closest supplier.
- C. Extra Materials:
  - 1. Package in clearly identified containers, or install where indicated.
  - 2. Indicate trade name, stock number, size, color, etc.
  - 3. Indicate where product is to be used.
  - 4. Indicate name, address and phone number of closest supplier.

**PART 3 - EXECUTION**

**3.1 DELIVERY**

- A. Deliver to Owner prior to substantial completion unless Owner requests earlier delivery.
- B. Deliver to location directed by Owner.
- C. Complete Maintenance Material Transmittal form at end of this Section.
  - 1. Acquire Owner's acceptance of items listed on transmittal.
  - 2. Transmittal to indicate USER's acceptance.
  - 3. Forward copy of transmittal forms with USER's acceptance to Owner.

**END OF SECTION**

## SPARE PARTS, TOOLS AND MAINTENANCE MATERIAL TRANSMITTAL

---

Project:

To USER:

Date:

From C.M./Contractor:

---

Package extra material, maintenance materials, spare parts, and tools in clearly identified boxes; indicate manufacturer's name, trade name, part name, stock number, size, color, etc. Indicate which item maintenance material is to be used with, piece of equipment part or tool is for, or where extra material is to be used. Indicate name, address, and phone of closest supplier.

Section	Description	Quantity

USER's Verification and Acceptance

Accepted by: \_\_\_\_\_

Date: \_\_\_\_\_

Forward copy of this transmittal to the Owner.

DISTRIBUTION: ☐ OWNER    ☐ CONTRACTOR    ☐ C. M.    ☐ ARCHITECT/ENGINEER

**END OF TRANSMITTAL**

**SECTION 01 91 03**  
**COMPONENT AND SYSTEM COMMISSIONING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This section includes specifications for the Component and System Commissioning process to verify the proper installation and operation of the aquaculture systems

**PART 2 - PRODUCTS (NOT APPLICABLE)**

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Component Commissioning is not to be scheduled until the items outlined in 3.2 below have either been completed or scheduled for completion. Should the contractor request the Component Commissioning to be undertaken, if the ENGINEER's staff travels to the site and they find the project is not ready for the Component Commissioning, the Contractor shall pay the ENGINEER for all the ENGINEER's costs associated with the trip.
- B. Similarly, should System Commissioning be requested before the system is ready to operate and before all deficiencies discovered during the Component Commissioning have been addressed, the Contractor shall reimburse the ENGINEER for the costs associated with the trip.
- C. This Section covers aquaculture specific equipment commissioning. Coordinate efforts outlined in this specification with Section 01 75 00 which covers overall facility start-up.

**3.2 PRIOR TO COMMISSIONING VISIT**

- A. The Contractor will complete installation and Field Quality Control of all components outlined herein.
- B. FIELD QUALITY CONTROL
  - 1. Specific Field Quality Control, equipment startup and calibration requirements are outlined in individual specifications.
  - 2. Contractor will bring manufacturer's representatives or factory authorized technician to the project site to check the installation of all aquaculture-related components provided by Contractor in the project.
  - 3. Note that this trip is separate from the trip needed for Owner Demonstration and Training.
  - 4. Confirm all water control/transmission facilities and structures are cleaned of debris and ready to use.
  - 5. Provide training to contractor's personnel on the proper operation of the equipment.
- C. Draft Operation and Maintenance Manuals (O&M)
  - 1. Contractor is also expected to have submitted draft copies of all Operation and Maintenance (O&M) Manuals to ENGINEER for review a minimum of 2 weeks prior to the scheduled Component Commissioning dates.
  - 2. Contractor will also have available on site copies of these draft O&M Manuals for reference if required during Component Commissioning.

### **3.3 COMPONENT COMMISSIONING**

- A. Duration: **Up to 1.5 days.**
- B. After written notification from the Contractor that all subsystem components have been installed, operated and calibrated and all criteria outlined in 3.2 above have been met, the Contractor shall spend up to one day demonstrating component operation to the ENGINEER. This shall be called the Component Commissioning.
- C. The Contractor shall make adjustments where required and operate components within their normal anticipated range of operation. Contractor will be responsible for documenting the adjustments made during the demonstration. Similarly, the Contractor will develop a written list of operational deficiencies and corrective adjustments needed. The Contractor shall add to the list any deficiencies that the Owner's Representative or Owner detects.
- D. The Component Commissioning shall be conducted a minimum of 4 weeks prior to the System Commissioning and "Substantial Completion" stage of the project. All operational deficiencies discovered during the Component Commissioning shall be corrected.
- E. The following components shall be operated:
  - 1. Water supply system including pumps and all related electrical controls.
  - 2. Building: including rearing tanks and all accessories, water supply, overflow, and drainage piping systems.
  - 3. Process drain system including water control structures, and all related piping and measurement devices.
  - 4. Emergency Generators and Transfer Switches
  - 5. Process instrumentation and alarm system.
  - 6. Pond filling, draining and operations.
- F. At a minimum, sequence of operation as outlined in individual specification sections for each major component will be verified.
- G. Other minor components such as valves and standpipes will be operated as time permits.
- H. The ENGINEER will furnish a more detailed written agenda after the Contractor gives written notice of when the Contractor will be ready to perform the Component Commissioning and that the Equipment Startup and Calibration has been completed.
- I. The Contractor shall have qualified technicians on site at all times during the Component Commissioning who are completely familiar with the installed project components and are capable of starting/stopping equipment components and making corrective adjustments where required. Alternately, the Contractor shall be adequately trained to demonstrate equipment operation and make adjustments (unless noted otherwise in the individual specifications).
- J. ENGINEER and/or the Owner/User personnel will not operate any equipment unless give specific permission by the Contractor. Equipment will not be operated overnight or at other times when the equipment is not manned by Contractor's personnel.

### **3.3 SYSTEM DEMONSTRATION**

- A. Duration: **Up to 2 days.**
- B. Systems are to be operated attended during the day and unattended, over-night in so far as the Owner concurs. All component and system alarms will be enabled and operational to protect the equipment from damage.
- C. The Contractor is expected to complete all other construction requirements to the point where the project is considered Substantially Complete. Then, the Substantial Completion inspection can be held concurrently with the System Commissioning visit.
- D. After written notification from the Contractor(s) that all corrective adjustments revealed during the Component Commissioning have been completed, the aquaculture systems will be operated



continuously through a full range of normal hatchery operational requirements for a period of 2-3 days. The facility will be operated in a manner to mimic the actual production cycle for fish rearing and be operated overnight to confirm stable continuous operation. This shall be called the System Commissioning.

- E. The purpose of the System Commissioning is to operate all new hatchery systems through their normal, anticipated range of operation, to make adjustments where required, and to verify that all components work together properly.
- F. At a minimum, sequence of operation as outlined in individual specification sections for each major component will be verified.
- G. The ENGINEER will furnish a more detailed written agenda after the Contractor gives written notice of when the Contractor will be ready to perform the System Commissioning and that all component Commissioning deficiencies have been corrected.
- H. The Contractor shall have qualified technicians on site at all times during the System Commissioning who are completely familiar with the installed project components and are capable of starting/stopping equipment components and making corrective adjustments where required. Alternately, the Contractor shall be adequately trained to demonstrate equipment operation and make adjustments (unless noted otherwise in the individual specifications).
- I. The ENGINEER and Owner shall observe system demonstration which the Contractor shall document. The Contractor will develop a written list of operational deficiencies and corrective adjustments needed. The Contractor shall add to the list any deficiencies that the ENGINEER or Owner detects.
- J. All operational deficiencies discovered during the System Commissioning shall be corrected. The operational phase of the System Commissioning may be repeated (with Owner) as necessary to assure compliance with the specifications. At this time, the project can be considered Substantially Complete and further close-out activities will follow the Owner's established procedures. Any remaining deficiencies will be added to the punch list for corrective action.
- K. The above operational period is intended to reveal system characteristics when operating in a series of different design conditions as well as to reveal operational deficiencies. It is not intended as a substitute for the individual requirements for items defined in the detailed sections of these specifications.

### **3.4 DEMONSTRATION AND TRAINING**

- A. Owner Training is to occur after System Commissioning has been completed.
- B. Specific Owner Training requirements are also outlined in individual specifications.

### **END OF SECTION**

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## DIVISION 02

EXISTING CONDITIONS



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## **SECTION 02 00 00**

### **EXISTING CONDITIONS**

#### **PART 1 – GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 32 92 00- Seeding

##### **1.2 QUALITY ASSURANCE**

- A. Where equipment, accessories, or materials are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated in the contract documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

##### **1.3 CONTINUITY OF EXISTING TRAFFIC, PARKING, DRAINAGE, OPERATIONS AND UTILITIES**

- A. The hatchery will continue operation during this construction to the extent possible. Hatchery business traffic will continue to utilize the existing entrance roads and parking lots. Work efforts / schedules shall be coordinated with the hatchery staff.
  - 1. Spring months are typically the most critical months in terms of hatchery operations and any interruption of services during this time period would be deemed to be potentially critical and needs to be coordinated and scheduled with Hatchery Staff.
- B. Do not interrupt or change existing traffic, delivery, parking, or utility services without prior written approval from the Hatchery Staff. When an interruption is required, the Contractor shall coordinate the schedule with the Hatchery Staff to minimize disruptions. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.
- C. Verify the locations of any water, drainage, gas, sewer, electric, drainage, gas, sewer, electric, telephone, fuel, or other utilities and site features which may be encountered in any excavations or other sitework.

##### **1.4. PROTECTION OF EXISTING WORK AND FACILITIES**

- A. Verify the locations of, and protect, any signs, paved surfaces, buildings, structures, landscaping, streetlights, utilities, and all other such facilities that may be encountered or interfered with during the progress of the work. Take all measures necessary to safeguard all existing work and facilities which are outside the limits of the work or items which are within the construction limits but are intended to remain.
- B. Protect all paved, turf, and landscaped surfaces to remain. Protect all areas outside of the construction limits from the effects of erosion

##### **1.5 CONSTRUCTION LIMITS**

- A. Confine work to the minimum area reasonably necessary to undertake the work as determined by the Owner.

- B. All area disturbed by excavation and grading, plus such additional areas as are disturbed by construction related activities including construction access and storage and installation of materials shall be considered the "Construction Area."
- C. The Contractor shall coordinate his proposed "Laydown Area" with the Owner and Hatchery Staff and secure their approval on this proposed location.

## **1.5 EXISTING CONDITIONS ACCEPTANCE**

- A. The roads and facilities at the hatchery are as is.
- B. There is no certification by Owner that the current status of all roads/facilities will be adequate for Contractor's tasks or Contractor's means and methods.
- C. Any upgrade to the existing conditions of the site required by the Contractor to complete the tasks will be the responsibility of the Contractor.

## **1.1 PART 2 – PRODUCTS**

### **2.1. WARNING SIGNS**

- A. Provide all necessary warning signing as required by OSHA, these specifications, or as shown on the Drawings.

## **1.2 PART 3 – EXECUTION**

### **3.1 GENERAL**

- A. Perform all work in accordance with applicable manufacturer's instructions.
- B. Do not interrupt or change existing services without prior written approval from the Owner. When interruption is required, the Contractor shall coordinate the schedule with the Hatchery Staff to minimize disruptions. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.

### **3.2 CONSTRUCTION LIMITS**

- A. Acceptable staging areas are indicated on the Contract Drawings. Confine work to the minimum area required to execute the work as indicated on the Contract Drawings.

### **3.3 PROJECT SITE CONDITIONS**

- A. Maintain a clean, safe and orderly site.
- B. Provide adequate barricades, guards, warning lights, other protection required at excavation and hazards created by work.
- C. Control access to the site by only authorized personnel and vehicles.
- D. Maintain site housekeeping to provide for a safe and orderly project site. Collect and dispose of debris as they accumulate daily.
- E. Provide shoring, bracing, sheet piling, planking and forming required by the work.
- D. Locate and protect overhead and underground utilities, sidewalks, drains, curbs, trees (including roots) shrubs, ground cover, bench marks, monuments, other reference points, adjacent building, materials, and property owned by others that are to remain.
- E. Protect items and existing ponds and structures. If disturbed or destroyed, replace as directed, bearing responsibility for and replacement cost of damage arising from all operations connected with work. Video road and prior to construction and submit video to Owner.
- J. Be responsible for control measures to prevent damage from flooding, erosion, sedimentation to on-site and off-site areas.

- K. Minimize impact to existing pond operations to the extent possible and prevent debris from entering these ponds by the use of sediment control wattles or other appropriate measures.

### **3.4 SITE RESTORATION**

- A. Unless otherwise specified or noted on the Drawings, fully and completely restore the site to a condition present prior to the work. Restore the surface of all disturbed areas to a like condition of the surface prior to the work, including all roadways.
- B. Topsoil, fertilize, seed, and mulch (or sod) all disturbed landscaped areas with a minimum of four (4) inches of topsoil, fertilizer, seed, and mulch (or sod), or provide for the restoration of other landscaping materials as necessary. See also Section 32 92 00- Seeding.

### **3.5 CLEAN UP**

- A. Level off all waste disposal areas and clean up all areas used for the storage of materials or the temporary deposit of excavated earth. Remove all surplus material, tools and equipment.
- B. Thoroughly clean all sewers and structures and remove and dispose of all debris and mud.

**END OF SECTION**

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# DIVISION 03

CONCRETE



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**SECTION 03 05 05**  
**CONCRETE TESTING AND INSPECTION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Contractor requirements for testing of concrete and grout.
  - 2. Definition of Owner provided testing.
  - 3. Acceptance criteria for concrete.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 21 00 - Reinforcement.
  - 2. Section 03 31 30 - Concrete, Materials and Proportioning.
  - 3. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.
  - 4. Section 03 41 33 - Precast and Prestressed Concrete.

**1.2 RESPONSIBILITY AND PAYMENT**

- A. Hire a qualified testing agency to perform the following testing and provide test results to the Engineer.
  - 1. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
  - 2. Additional testing and inspection required because of changes in materials or proportions requested by Contractor.
  - 3. Testing and inspection of concrete and grout produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents.
  - 4. Additional testing or retesting of materials occasioned by their failure, be test or inspection, to meet requirements of the Contract Documents.
  - 5. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient.
  - 6. Other testing services needed or required by Contractor such as field curing of test specimens and testing of additional specimens for determining when forms, form shoring or reshoring may be removed.
  - 7. Pay for services defined in this Paragraph.
  - 8. Sampling and testing specified in Paragraphs 1.2A.3. through 1.2A.6. inclusive, shall be witnessed by Owner's Special Inspector.
    - a. Contractor to coordinate scheduling of Owner's Special Inspector.
    - b. Provide minimum 24 HR notice to Owner's Special Inspector.
    - c. Reimburse Owner for non-productive time incurred by Owner's Special Inspector if production sampling and testing event is delayed, interrupted, extended or aborted due to factors within the control of the Contractor.
  - 9. See Specification Section 01 30 00.
- B. Duties and Authorities of Testing Agency/Service Provider:
  - 1. Any Testing Agency/Service Provider or agencies and their representatives retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or release any requirement of Contract Documents, nor to reject, approve or accept any portion of the Work.
  - 2. Testing Agency/Service Provider shall inform the Contractor and Engineer regarding acceptability of or deficiencies in the work including materials furnished and work performed by Contractor that fails to fulfill requirements of the Contract Documents.
  - 3. Testing Agency to submit test reports and inspection reports to Engineer and Contractor immediately after they are performed.

- a. All test reports to include exact location in the work at which batch represented by a test was deposited.
- b. Reports of strength tests to include detailed information on storage and curing of specimens prior to testing.
- 4. Owner retains the responsibility for ultimate rejection or approval of any portion of the Work.

### **1.3 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Concrete Institute (ACI):
    - a. 318, Building Code Requirements for Structural Concrete.
  - 2. ASTM International (ASTM):
    - a. ASTM Cement and Concrete Reference Laboratory (CCRL).
    - b. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
    - c. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
    - d. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
    - e. C94, Standard Specification for Ready-Mixed Concrete.
    - f. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.
    - g. C172, Standard Practice for Sampling Freshly Mixed Concrete.
    - h. C1019, Standard Test Method for Sampling and Testing Grout.
    - i. C1218, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
    - j. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- B. Qualifications:
  - 1. Contractor's Testing Agency:
    - a. Meeting requirements of ASTM E329 and ASTM C94.
    - b. Provide evidence of recent inspection by CCRL of NBS, and correction of deficiencies noted.
- C. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.

### **1.4 DEFINITIONS**

- A. Testing Agency/Service Provider: An independent professional testing/inspection firm or service hired by Contractor or by Owner to perform testing, inspection or analysis services as directed, and as provided in the Contract Documents.

### **1.5 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Concrete materials and concrete mix designs proposed for use.
      - 1) Include results of all testing performed to qualify materials and to establish mix designs.
      - 2) Place no concrete until approval of mix designs has been received in writing.
      - 3) Submittal for each concrete mix design to include:
        - a) Sieve analysis and source of fine and coarse aggregates.
        - b) Test for aggregate organic impurities.
        - c) Proportioning of all materials.
        - d) Type of cement with mill certificate for the cement.
        - e) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Specification Section 03 31 30.
        - f) Slump.

- g) Brand, type and quantity of air entrainment and any other proposed admixtures.
  - h) Shrinkage test results.
  - i) Total water soluble chloride ion concentration in hardened concrete from all ingredients determined per ASTM C1218.
  - j) 28-day compression test results and any other data required by Specification Section 03 31 30 to establish concrete mix design.
2. Certifications:
- a. Testing Agency qualifications.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 TESTING SERVICES TO BE PERFORMED SERVICE PROVIDER/TESTING AGENCY**

- A. The following concrete testing will be performed by the Service Provider/Testing Agency:
- 1. Concrete strength testing:
    - a. Secure concrete samples in accordance with ASTM C172.
      - 1) Obtain each sample from a different batch of concrete on a random basis, avoiding selection of test batch other than by a number selected at random before commencement of concrete placement.
    - b. For each strength test, mold and cure cylinders from each sample in accordance with ASTM C31.
      - 1) Record any deviations from requirements on test report.
      - 2) Cylinder size: Per ASTM C31.
        - a) 4 inches cylinders shall not be used for concrete mixes with maximum aggregate size larger than 1 inch.
        - b) Use the same size cylinder for all tests for each concrete mix.
      - 3) Quantity:
        - a) 6 inches diameter by 12 inches high: Four cylinders.
        - b) 4 inches diameter by 8 inches high: Six cylinders.
    - c. Field cure one cylinder for the seven day test.
      - 1) Laboratory cure the remaining.
    - d. Test cylinders in accordance with ASTM C39.
      - 1) 6 inches diameter cylinders:
        - a) Test two cylinders at 28 days for strength test result and the one field cured sample at seven days for information.
        - b) Hold remaining cylinder in reserve.
      - 2) 4 inches diameter cylinders:
        - a) Test three cylinders at 28 days for strength test result and the one field cured cylinder at seven days for information.
        - b) Hold remaining cylinders in reserve.
    - e. Strength test result:
      - 1) Average of strengths of two, 6 inches diameter cylinders or three, 4 inches diameter cylinders from the same sample tested at 28 days.
      - 2) If one cylinder in a test manifests evidence of improper sampling, molding, handling, curing, or testing, discard and test reserve cylinder(s); average strength of remaining cylinders shall be considered strength test result.
      - 3) Should all cylinders in any test show any of above defects, discard entire test.
    - f. Frequency of tests:
      - 1) All other concrete:
        - a) One strength test to be taken not less than once a day, nor less than once for each 60 cubic yards or fraction thereof placed in any one day.
        - b) Once for each 5000 square feet of slab or wall surface area placed each day

- c) If total volume of concrete on Project is such that frequency of testing required in above paragraph will provide less than five strength tests for each concrete mix, tests shall then be made from at least five randomly selected batches or from each batch if fewer than five batches are provided.
- 2. Slump testing:
  - a. Determine slump of concrete sample for each strength test.
    - 1) Determine slump in accordance with ASTM C143.
  - b. If consistency of concrete appears to vary, the Engineer or Owner's Representative shall be authorized to require a slump test for each concrete truck.
    - 1) This practice shall continue until three consecutive batches are determined to be consistent and meet the slump requirements specified.
- 3. Air content testing: Determine air content of concrete sample for each strength test in accordance with ASTM C231
- 4. In-place concrete testing (if required).

### 3.2 SPECIAL INSPECTIONS

- A. See Section 01 45 33.
  - 1. Special Inspections listed are for the Contractor reference only and is not part of the Contract Documents.
  - 2. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.
- B. Formwork Special Inspections:
  - 1. Shape, location, and dimensions.
    - a. Inspect in accordance with dimensions and details on Drawings.
    - b. Frequency: Inspect prior to each concrete pour.
- C. Reinforcing Special Inspections:
  - 1. Reinforcing size, spacing, lap length and concrete cover.
    - a. Inspect in accordance with Drawings and Specification.
    - b. Frequency: Inspect prior to each concrete pour.
  - 2. Reinforcing adhesive anchoring system:
    - a. Inspect in accordance with ICC-ES report.
    - b. Frequency:
      - 1) Inspect all adhesive anchors for the first 4 hours of installation.
      - 2) Inspect approximately 25% of adhesive anchors thereafter.
      - 3) Additional inspection will be required for different installer or if the quality of installation appears to vary.
- D. Mixing, Placing, Jointing, and Curing Special Inspections:
  - 1. Perform concrete tests per the requirements of this Specification Section.
  - 2. Verification of proper mix design.
    - a. Frequency: Periodically, prior to each concrete pour.
  - 3. Proper concrete placement techniques.
    - a. Inspect per requirements of Section 03 31 31.
    - b. Frequency: During each concrete pour.
  - 4. Proper curing temperature and techniques.
    - a. Inspect per requirements of Section 03 31 31.
    - b. Frequency: Periodically, but not less than every third day.
  - 5. Joints:
    - a. Inspect joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.
    - b. Frequency: Prior to each concrete pour.
  - 6. Waterstops:
    - a. Visually inspect waterstops for proper location, continuity, installation to prevent displacement, cleanliness and damage to waterstop.

- b. Frequency:
    - 1) Prior to each concrete pour.
- E. Anchorage to Concrete Special Inspection:
  - 1. Post installed anchors as required by the building code, ICC-ES Evaluation Reports, and as specified by the Engineer.
    - a. Frequency: Per ICC-ES Report.
  - 2. Cast-in-place concrete anchors, including anchor size, embedment, material and location.
    - a. Frequency: Prior to each concrete pour.

### **3.3 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER**

- A. To facilitate testing and inspection, perform the following:
  - 1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
  - 2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 hours as required by ASTM C31.
  - 3. Take samples at point of placement into concrete member.
- B. Notify Engineer Contractor's Testing Agency sufficiently in advance of operations (minimum of 24 hours) to allow for assignment of personnel and for scheduled completion of quality tests.

### **3.4 ACCEPTANCE**

- A. Completed concrete work which meets applicable requirements will be accepted without qualification.
- B. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.
- C. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents.
  - 1. In this event, modifications may be required to assure that concrete work complies with requirements.
  - 2. Modifications, as directed by Engineer, to be made at no additional cost to Owner.
- D. Dimensional Tolerances:
  - 1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.
  - 2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal.
    - a. If removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.
  - 3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.
  - 4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected.
    - a. Repair or remove and replace if required.
  - 5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected.
    - a. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.
- E. Appearance:
  - 1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.

2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the long-term strength or function of the member.
- F. High Water-Cement Ratio:
1. Concrete with water in excess of the specified maximum water-cement ratio will be rejected.
  2. Remove and replace concrete with high water-cement ratio or make other corrections as directed by Engineer.
- G. Strength of Structure:
1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
    - a. Low concrete strength:
      - 1) Test results for standard molded and cured test cylinders to be evaluated separately for each mix design.
        - a) Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards.
        - b) For evaluation of potential strength and uniformity, each mix design shall be represented by at least three strength tests.
        - c) A strength test shall be the average of two, 6 inches diameter cylinders or three, 4 inches diameter cylinders from the same sample tested at 28 days.
      - 2) Acceptance:
        - a) Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
          - (1) Average of all sets of three consecutive strength tests equal or exceed the required specified 28 day compressive strength.
          - (2) No individual strength test falls below the required specified 28 day compressive strength by more than 500 psi.
    - b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Specification Section 03 21 00 or requirements of the Contract Drawings or approved Shop Drawings.
    - c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
    - d. Curing time and procedure not meeting requirements of this Specification Section.
    - e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
    - f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
    - g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength or durability.
  2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
  3. In-place testing of concrete may be required when strength of concrete in place is considered potentially deficient.
    - a. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the structure or for selecting areas to be cored.
      - 1) Such tests shall not be used as a basis for acceptance or rejection.
    - b. Core tests:
      - 1) Where required, test cores will be obtained in accordance with ASTM C42.
        - a) If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60%) for seven days before test then test dry.



- b) If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 hours and test wet.
  - c) Testing wet or dry to be determined by Engineer.
- 2) Three representative cores may be taken from each member or area of concrete in place that is considered potentially deficient.
  - a) Location of cores shall be determined by Engineer so as least to impair strength of structure.
  - b) If, before testing, one or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
- 3) Concrete in area represented by a core test will be considered adequate if average strength of three cores is equal to at least 85% of specified strength and no single core is less than 75% of specified strength.
- 4) Fill core holes with non-shrink grout and finish to match surrounding surface when exposed in a finished area.
- 4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with ACI 318, Chapter 20.
- 5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
- 6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

#### **END OF SECTION**

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## **SECTION 03 11 13**

### **FORMWORK**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Formwork requirements for concrete construction.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 05 05 - Concrete Testing and Inspection.
  - 2. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
  - 3. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Concrete Institute (ACI):
    - a. CT-13, Concrete Terminology.
    - b. 117, Specification for Tolerances for Concrete Construction and Materials.
    - c. 347R, Guide to Formwork for Concrete.
- B. Qualifications:
  - 1. Formwork, shoring and reshoring to be designed by a licensed professional engineer currently registered or having a minimum of three years of experience in this type of design work.
    - a. Above qualifications apply to slabs and beams not cast on the ground.
- C. Miscellaneous:
  - 1. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the Contractor.
  - 2. Design requirements:
    - a. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code.
      - 1) Where conflicts occur between the above two standards, the more stringent requirements shall govern.
    - b. Design formwork to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.

##### **1.3 DEFINITIONS**

- A. Words and terms used in these Specifications are defined in ACI CT-13.
- B. SCC: Self-Consolidating Concrete.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for the requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Manufacturer and type of proposed form ties.
- B. Samples:
  - 1. A 12 inches SQ sample of each of the following form finishes.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Forms for Surfaces Exposed to View:
  - 1. Wood forms:
    - a. 5/8 or 3/4 inches 5-ply faced structural plywood of concrete form grade.
    - b. Built-in-place or prefabricated type panel.
  - 2. Metal forms:
    - a. Metal forms may be used except for aluminum in contact with concrete.
    - b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.
- B. Forms for Surfaces Not Exposed to View:
  - 1. Wood or metal sufficiently tight to prevent leakage.
  - 2. Do not use aluminum forms.

### **2.2 ACCESSORIES**

- A. Form Ties:
  - 1. Commercially fabricated for use in form construction.
    - a. Field fabricated ties are unacceptable.
  - 2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
  - 3. Embedded portion of ties to be not less than 1-1/2 inches from face of concrete after ends have been removed.
  - 4. Cone size:
    - a. 3/4 inches minimum diameter cones on both ends.
    - b. Depth of cone not to exceed the concrete reinforcing cover.
  - 5. Provide ties with built-in waterstops in all walls that will be in contact with
  - 6. Through-wall ties that are designed to be entirely removed are not allowed in all walls that will be in contact with liquids during plant operation.
- B. Form Release Material:
  - 1. If project contains self-consolidating concrete, provide reactive, vegetable based product, not barrier type.
- C. Void Forms:
  - 1. Constructed from double faced corrugated cardboard or fiberboard which is wax impregnated and laminated with moisture-resistant adhesive.
  - 2. Capable of resisting moisture with no loss of load carrying strength or change in depth or configuration.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Form Surface Treatment:
  - 1. Before placing of reinforcing steel or concrete, cover surfaces of forms with an approved release material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes.
    - a. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
  - 2. Do not allow excess form release material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.
- B. Apply form release material to minimize bugholes and pinholes. Follow manufacturer's printed installation instructions specific to the form facing material.

- C. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.
  - 1. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 feet apart.
- D. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

### 3.2 ERECTION

- A. Install products in accordance with manufacturer's instructions.
- B. Tolerances:
  - 1. Conform to ACI 117.
  - 2. Variation from plumb:
    - a. In lines and surfaces of columns, piers, walls, and in risers.
      - 1) Maximum in any 10 feet of height: 1/4 inches.
      - 2) Maximum for entire height: 1/2 inches.
    - b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
      - 1) Maximum in any 20 feet length: 1/4 inches.
      - 2) Maximum for entire length: 1/2 inches.
  - 3. Variation from level or from grades specified:
    - a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores.
      - 1) Maximum in any 10 feet of length: 1/4 inches.
      - 2) Maximum in any bay or in any 20 feet length: 3/8 inches.
      - 3) Maximum for entire length: 3/4 inches.
    - b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
      - 1) Maximum in any bay or in 20 feet length: 1/4 inches.
      - 2) Maximum for entire length: 1/2 inches.
  - 4. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
    - a. Maximum in any bay: 1/2 inches.
    - b. Maximum in any 20 feet of length: 1/2 inches.
    - c. Maximum for entire length: 1 inch.
  - 5. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of +1/2 inches.
  - 6. Variation in horizontal plan location of beam, column and wall centerlines from required location: Maximum of +1/2 inches.
  - 7. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls: Maximum of -1/4 inches, +1/2 inches.
  - 8. Footings and foundations:
    - a. Variations in concrete dimensions in plan: -1/2 inches, +2 inches.
    - b. Misplacement or eccentricity:
      - 1) 2% of footing width in direction of misplacement but not more than 2 inches.
    - c. Thickness:
      - 1) Decrease in specified thickness: 5%.
      - 2) Increase in specified thickness: No limit except that which may interfere with other construction.
  - 9. Variation in steps:
    - a. In a flight of stairs:
      - 1) Rise: +1/8 inches.
      - 2) Tread: +1/4 inches.
    - b. In consecutive steps:
      - 1) Rise: +1/16 inches.

- 2) Tread: +1/8 inches.
- 10. Establish and maintain in an undisturbed condition and until final completion and acceptance of Project, sufficient control points and benchmarks to be used for reference purposes to check tolerances.
- 11. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of Project.
- 12. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.
- C. Make forms sufficiently tight to prevent loss of mortar from concrete.
- D. Place 3/4 inches chamfer strips in exposed to view corners of forms to produce 3/4 inches wide beveled edges.
- E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 inch.
  - 1. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface.
  - 2. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints or at construction joints.
- F. Where circular walls are to be formed and forms made up of straight sections are proposed for use, provide straight lengths not exceeding 2 feet wide.
  - 1. Brace and tie formwork to maintain correct position and shape of members.
- G. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract swelling.
- H. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.
- I. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.
- J. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation.
  - 1. Securely brace forms against lateral deflection.
  - 2. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.

### **3.3 REMOVAL OF FORMS**

- A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.
- B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging.
  - 1. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing specified in Specification Section 03 31 31.
- D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
  - 1. For walls of water containing structures, leave forms in place for a minimum of 72HRS.

- F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28-day compressive strength.
  - 1. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.
- G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

### **3.4 FIELD QUALITY CONTROL**

- A. Special Inspection:
  - 1. See Section 01 45 33.
  - 2. See Section 03 05 05.

**END OF SECTION**

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## **SECTION 03 15 19**

### **ANCHORAGE TO CONCRETE**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Requirements for all cast-in-place anchor bolts, anchor rods, reinforcing anchorage adhesive, and post-installed concrete anchors required for the Project but not specified elsewhere in the Contract Documents.
  - 2. Design of all concrete anchors not indicated on the Drawings including, but not limited to, installation of anchors into concrete for the following structural and nonstructural components:
    - a. Structural members and accessories.
    - b. Metal, wood, and plastic fabrications.
    - c. Architectural components.
    - d. Mechanical and electrical equipment and components.
    - e. Plumbing, piping, and HVAC work.
    - f. All other components requiring attachment to concrete.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 05 05 - Concrete Testing and Inspection.
  - 2. Section 40 05 07 - Pipe Support Systems.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Concrete Institute (ACI):
    - a. 318, Building Code Requirements for Structural Concrete and Commentary.
    - b. 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
    - c. 355.2, Seismic Testing of Post-Installed Concrete and Masonry Anchors in Cracked Concrete.
    - d. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
  - 2. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
    - a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
  - 3. American Institute of Steel Construction (AISC):
    - a. 303, Code of Standard Practice for Steel Buildings and Bridges.
  - 4. ASTM International (ASTM):
    - a. A36, Standard Specification for Carbon Structural Steel.
    - b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
    - c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - d. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - e. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
    - f. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
    - g. A563, Standard Specification for Carbon and Alloy Steel Nuts.
    - h. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
    - i. F436, Standard Specification for Hardened Steel Washers.
    - j. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
    - k. F594, Standard Specification for Stainless Steel Nuts.

- l. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
  - m. F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
- 5. ICC Evaluation Service (ICC-ES):
  - a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
  - b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- B. Qualifications:
  - 1. Anchor designer for Contractor-designed post-installed anchors and cast in place anchorage shall be a professional structural engineer licensed in the State that the Project is located in.
  - 2. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Engineer.
- C. Post-installed anchors and related materials shall be listed by the following agencies:
  - 1. ICC-ES.
  - 2. Engineer approved equivalent.

### **1.3 DEFINITIONS**

- A. Adhesive Anchors:
  - 1. Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.
  - 2. Includes anchors using acrylics, epoxy and other similar adhesives.
- B. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e. bolt) material.
- C. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.
- D. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.
- E. Galvanizing: Hot-dip galvanizing per ASTM A123, ASTM A153 or ASTM F2329 with minimum coating of 2.0 oz of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.
- F. Hardware: As defined in ASTM A153.
- G. Installer or Applicator:
  - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  - 2. Installer and applicator are synonymous.
- H. MPII: Manufacturer's printed installation instructions.
- I. Mechanical Anchors:
  - 1. Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
  - 2. Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
  - 3. Drop-in anchors and other similar non-ICC ES approved anchors are not allowed.
- J. Post-Installed Anchor: Any adhesive or mechanical anchor installed into previously placed and adequately cured concrete.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that submitted products meet requirements of referenced standards.

- b. Manufacturer material data sheet for each anchor.
    - 1) Clearly indicate which products on the data sheet are proposed for use on the Project.
  - c. Manufacturer's printed installation instructions.
  - d. Current ICC-ES report for each post-installed anchor system indicating the following:
    - 1) Certification that anchors meet all requirements indicated in this Specification.
    - 2) Performance data showing that anchor is approved for use in cracked concrete.
    - 3) Seismic design categories for which anchor system has been approved.
    - 4) Required installation procedures.
    - 5) Special inspection requirements for installation.
  - e. Contractor Designed Anchors:
    - 1) Show diameter and embedment depth of each anchor.
    - 2) Indicate compliance with ACI 318, Appendix D ACI 318, Chapter 17, ACI 350 Appendix E.
    - 3) Design tension and shear loads used for anchor design.
    - 4) Engineering design calculations:
      - a) Indicate design load to each anchor.
      - b) Develop anchor forces based on Design Criteria listed herein and/or manufacturer's design information.
      - c) Sealed and signed by contractor's professional structural engineer.
      - d) Calculations will be submitted for information purposes only.
    - 5) Provide torque values where pipe sleeves anchors are used.
  - f. Anchorage layout drawings and details:
    - 1) Indicate anchor diameter, embedment, length, anchor type, material and finish.
    - 2) Drawings showing location, configuration, spacing and edge distance.
    - 3) Type of post-installed anchor system used.
      - a) Provide manufacturer's ICC-ES report for the following:
        - (1) Mechanical anchorage per ICC-ES AC193.
        - (2) Adhesive anchorage per ICC-ES AC308.
- B. Samples:
- 1. Representative samples of concrete anchors may be requested by Engineer. Review will be for type and finish only. Compliance with all other requirements is exclusively the responsibility of the Contractor.
- C. Informational Submittals:
- 1. Certification of qualifications for each installer of post-installed anchors.
    - a. Indicate successful completion or certification for each type of approved post-installed anchor as required by the Contract Documents.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to job site in manufacturer's or distributor's packaging undamaged and complete with installation instructions.
- B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.
- C. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Cast-in-place Concrete Anchors:
  - 1. Building and nonbuilding structures, unless otherwise specified:

- a. ASTM F1554, Grade 36 or Grade 55 with weldability supplement S1 for galvanized or non-galvanized threaded rods.
  - b. ASTM A307, Grade A for galvanized headed bolts.
  - c. For Submerged or used in enclosed tankage, ASTM F593, Type 316.
- 1. All other cast-in-place concrete anchors for equipment:
  - a. Stainless steel with matching nut and washer.
  - b. Submerged application: ASTM F593, Type 316.
  - c. Non-submerged application: ASTM F593, Type 304 or Type 316 anchors and washers
  - d. Nuts for non-submerged applications, ASTM563 and coated after torqued.
- B. Post-Installed Mechanical and Adhesive Concrete Anchors:
  - 1. Stainless steel with matching nut and washer.
  - 2. Submerged application: ASTM F593, Type 316.
  - 3. Non-submerged application: ASTM F593, Type 304 or Type 316, with ASTM A563 nuts coated after torquing.
- C. Reinforcement: See Section 03 21 00.
- D. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.
- E. Deformed Bar Anchors: ASTM A496 with minimum yield strength of 70,000 psi and a minimum tensile strength of 80,000 psi.
- F. Washers:
  - 1. ASTM F436 unless noted otherwise, finish to match bolt.
  - 2. If stainless steel anchorage is being used for cast-in-place anchorage, furnish washers of the same material and alloy as in the accompanying anchorage.
  - 3. Plate washers: Minimum 1/2 inches thick fabricated ASTM A36 square plates as specified or required.
  - 4. Follow manufacturer's requirements for all post-installed anchorage.
- G. Nuts:
  - 1. ASTM A563 for all cast-in-place anchorage.
  - 2. If stainless steel anchorage is being used for cast-in-place anchorage in submerged or enclosed tankage, nuts shall meet ASTM F594 and be the matching material and alloy as in the accompanying anchorage.
  - 3. Follow manufacturer's requirements if using post-installed anchorage.
- H. Galvanizing Repair Paint:
  - 1. High zinc dust content paint for regalvanizing welds and abrasions.
  - 2. ASTM A780.
  - 3. Zinc content: Minimum 92% in dry film.
  - 4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."

## 2.2 CONTRACTOR DESIGNED ANCHORAGE

- A. Manufacturers:
  - 1. Post-installed anchor systems for the listed manufacturers will be considered only if a current ICC-ES evaluation report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section and if the anchor system is approved by the Engineer.
    - a. Hilti.
    - b. Dewalt.
    - c. Simpson Strong-Tie.
- B. Design the anchorage when any of the following occur:
  - 1. Design load for concrete anchorage is shown on the Drawings.
  - 2. When specifically required by the Contract Documents.
  - 3. When an anchorage is required but not specified in the Drawings.

- C. Anchorage Design Loads:
  - 1. Determine all of the design loads, including wind and seismic loads, per the building code. Additionally, specialty engineer is required to incorporate all static and dynamic loading forces established by the equipment manufacturer, where required for equipment.
    - a. Anchorage of equipment and non-structural components: Use the actual dead and operating loads provided by the manufacturer.
- D. When Contract Drawings indicate an anchor diameter or length, design shall incorporate these as “minimums.” Design these anchors and provide all necessary documentation as required herein.
- E. Cast-in-Place Concrete Anchors:
  - 1. Provide the material, nominal diameter, embedment length, spacing, edge distance and design capacity to resist the calculated load based on the requirements given in the building code including ACI 318, Appendix D, ACI 318, Chapter 17.
  - 2. Design assuming cracked concrete.
- F. Post-installed Concrete Anchors:
  - 1. Provide the manufacturer’s system name/type, nominal diameter, embedment depth, spacing, minimum edge distance, cover, and design capacity to resist the specified or calculated load based on requirements given in the building code, ACI 318, Chapter 17 and current ICC-ES report, for the anchor to be used.
  - 2. Design assuming cracked concrete.

## **2.3 ENGINEER DESIGNED ANCHORAGE**

- A. When the size, length and details of anchorages are shown on Contract Structural Drawings, Contractor design of anchorage is not required unless otherwise indicated.
- B. Manufacturers:
  - 1. Additional newer post-installed anchor systems for the listed manufacturers will be considered only if a current evaluation agency report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section, the anchor system is certified by ICC-ES for cracked concrete conditions, and if approved by the Engineer.
  - 2. Mechanical Anchors:
    - a. Hilti:
      - 1) Kwik Bolt TZ (ICC-ES ESR-1917).
  - 3. Adhesive Concrete Anchors:
    - a. Hilti:
      - 1) HIT RE 500 V3 (ICC ESR-3814).
  - 4. Concrete Screw Anchors:
    - a. Hilti:
      - 1) Kwik HUS-EZ Screw (ICC-ES ESR-3027).
    - b. Substitution request to indicate the proposed anchor has at least the same tension and shear strength as the specified anchor installed as indicated in the Contract Drawings.
    - c. Calculations to be stamped by a Professional Engineer registered in the state that the Project is located in.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Cast-in-Place Anchorage:
  - 1. Use where anchor rods or bolts are indicated on the Drawings, unless another anchor type is approved by the Engineer.
  - 2. Provide concrete anchorage as shown on the Drawings or as required to secure components to concrete.
- B. Adhesive Anchorage:

1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
  2. May be used where subjected to vibration or where buried or submerged.
  3. Do not use in overhead applications or sustained tension loading conditions such as utility hangers.
  4. Contact Engineer for approval when anchors will not be installed in compliance with MPII
- C. Mechanical Anchorage:
1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
  2. Do not use where subjected to vibration.
  3. May be used in overhead applications.
  4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.
- D. Do not use powder actuated fasteners and other types of bolts and fasteners not specified herein for structural applications unless approved by the Engineer or specified in Contract Documents.

### **3.2 PREPARATION**

- A. Provide adequate time to allow for proper installation and inspection prior to placing concrete for cast-in-place concrete anchorage.
- B. Prior to installation, inspect and verify areas and conditions under which concrete anchorage is to be installed.
1. Notify Engineer of conditions detrimental to proper and timely completion of work.
  2. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
- C. Special Inspection is required in accordance with the building code for all concrete anchorage.
1. Notify the Special Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
  2. See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section for additional requirements.
- D. Post-installed anchor manufacturer's representative shall demonstrate and observe the proper installation procedures for the post-installed anchors at no additional expense to the Owner.
1. Follow such procedures to assure acceptable installation.
  2. Adhesive anchors must be installed in concrete aged a minimum of 21 days.

### **3.3 INSTALLATION**

- A. Tie cast-in-place anchorage in position to embedded reinforcing steel using wire.
1. Tack welding of anchorage is prohibited.
  2. Chase threads as required and coat the projected portion of carbon steel anchors and nut threads with a heavy coat of clean grease after concrete has cured.
  3. Anchorage location tolerance shall be in accordance with AISC 303.
  4. Provide steel or durable wood templates for all column and equipment anchorage.
    - a. Templates to be placed above top of concrete and not impede proper concrete placement and consolidation.
- B. Unless noted or specified otherwise:
1. Connect aluminum and steel members to concrete and masonry using stainless steel cast-in-place anchorage unless shown otherwise.
  2. Provide washers for all anchorage.
  3. Where exposed, extend threaded anchorage a maximum of 3/4 inches and a minimum of 1/2 inches above the top of the fully engaged nut.
    - a. If anchorage is cut off to the required maximum height, threads must be dressed to allow nuts to be removed without damage to the nuts.

- C. Do the following after nuts are snug-tightened down:
  - 1. If using post-installed anchorage, follow MPII.
  - 2. Upset threads of anchorage to prevent nuts from backing off.
    - a. Provide double nut or lock nut in lieu of upset threads for items that may require removal in the future.
  - 3. For all other cast-in-place anchorage material, tighten nuts down an additional 1/8 turn beyond snug tight to prevent nuts from backing off.
  - 4. If two nuts are used per concrete anchor above the base plate, tighten the top nut an additional 1/8 turn to "lock" the two nuts together.
  - 5. If using post-installed anchorage, follow MPII.
- D. Assure that embedded items are protected from damage and are not filled in with concrete.
- E. Secure architectural components such that it will not be aesthetically distorted and fasteners will not be overstressed from expansion, contraction, or installation.
- F. Repair damaged galvanized surfaces in accordance with ASTM A780.
  - 1. Prepare damaged surfaces by abrasive blasting or power sanding.
  - 2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions and ASTM A780.
- G. For post-installed anchors, comply with the MPII on the hole diameter and depth required to fully develop the tensile strength of the anchor or reinforcing bar.
  - 1. Use hammer drills to create holes.
  - 2. Properly clean out the hole per the ICC-ES reports utilizing a non-metallic fiber bristle brush and compressed air or as otherwise required to remove all loose material from the hole prior to installing the anchor in the presence of the Special Inspector.

### **3.4 FIELD QUALITY CONTROL**

- A. Special Inspection:
  - 1. See Section 01 45 33.
  - 2. See Section 03 05 05.
- B. Field Inspection and Testing
  - 1. Owner reserves the right to inspect and test completed anchorage at a minimum of 10% (for large quantity) to 25% (smaller quantity) to 100% (very small project quantity).
  - 2. Such testing shall conform to requirements of ACI 355.2 and/or ACI 355.4 as applicable.
  - 3. Failed anchors shall be satisfactorily replaced at no cost to Owner.

### **3.5 CLEANING**

- A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.

## **END OF SECTION**

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## **SECTION 03 21 00**

### **REINFORCEMENT**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Reinforcing bar requirements for concrete construction.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 05 05 - Concrete Testing and Inspection.
  - 2. Section 03 15 19 - Anchorage to Concrete.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Concrete Institute (ACI):
    - a. SP 66, ACI Detailing Manual.
    - b. 117, Specification for Tolerances for Concrete Construction and Materials.
    - c. 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
    - d. 318, Building Code Requirements for Structural Concrete.
  - 2. ASTM International (ASTM):
    - a. A36, Standard Specification for Carbon Structural Steel.
    - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
    - c. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
    - d. A706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
    - e. A970, Standard Specification for Headed Steel Bars for Concrete Reinforcement.
    - f. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - 3. Concrete Reinforcing Steel Institute (CRSI):
    - a. Manual of Standard Practice.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Mill certificates for all reinforcing.
    - d. Manufacturer and type of proprietary reinforcing mechanical splices.
  - 2. Qualifications of welding operators, welding processes and procedures.
  - 3. Reinforcing number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and reinforcing supports.
  - 4. Sufficient reinforcing details to permit installation of reinforcing.
  - 5. Reinforcing details in accordance with ACI SP 66 and ACI 315.
  - 6. Locations where proprietary reinforcing mechanical splices are required or proposed for use.
  - 7. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without reference to Contract Drawings.
    - a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on the Contract Drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of all reinforcing steel.

- b. Where multiple types of supports for reinforcing steel (such as chairs, runners, bolsters, and other types of supports) will be used in the Work, clearly indicate on the Shop Drawings the support types and materials of supports.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Support and store all reinforcing above ground.
- B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the Shop Drawing mark numbers.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURES**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Reinforcing adhesive anchors:
    - a. See Specification Section 03 15 19.
  - 2. Reinforcing mechanical splices:
    - a. Lenton Rebar Splicing by Erico, Inc.
    - b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
    - c. Bar-Grip Systems by Barsplice Products, Inc.

#### **2.2 MATERIALS**

- A. Reinforcing Bars: ASTM A615, grade 60, deformed.
- B. Reinforcing Bars to be Welded: ASTM A706, Grade 60, deformed.
- C. Welded Wire Reinforcement: ASTM A1064 .
- D. Smooth Dowel Bars:
  - 1. Water containing structures: ASTM A276, Type 304.
  - 2. All other locations: ASTM A36, with metal end cap to allow longitudinal movement equal to joint width plus 1 inch.
- E. Reinforcing Adhesive Anchors:
  - 1. See Specification 03 15 19.

#### **2.3 ACCESSORIES**

- A. Chairs, Runners, Bolsters, Spacers, Hangers, and Other Reinforcing Supports:
  - 1. Metal fabrications with plastic-coated tips in contact with forms.
    - a. Plastic coating meeting requirements of CRSI Manual of Standard Practice.
  - 2. All plastic construction meeting the requirements of CRSI Manual of Standard Practice.
    - a. 100% non-metallic, non-corrosive.
    - b. Required for all walls and elevated construction exposed to liquid containing structures.
- B. Protective plastic caps at mechanical splices.

#### **2.4 FABRICATION**

- A. Tolerances:
  - 1. Conforms to ACI 117, except as modified herein.
  - 2. Sheared lengths: +1 inches.
  - 3. Overall dimensions of stirrups, ties and spirals: +1/2 inches.
  - 4. All other bends: +0 inches, -1/2 inches.
- B. Minimum diameter of bends measured on the inside of the reinforcing bar to be as indicated in ACI 318 Paragraph 7.2.
- C. Ship reinforcing to jobsite with attached plastic or metal tags.

1. Place on each tag the mark number of the reinforcing corresponding to the mark number indicated on the Shop Drawing.
2. Mark numbers on tags to be so placed that the numbers cannot be removed.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Tolerances:
  1. Conform to ACI 117, except as modified herein.
  2. Reinforcing placement:
    - a. Clear distance to formed surfaces: +1/4 inches.
    - b. Minimum spacing between bars: -1/4 inches.
    - c. Top bars in slabs and beams:
      - 1) Members 8 inches deep or less: +1/4 inches.
      - 2) Members between 8 inches and 2 feet deep: -1/4 inches, +1/2 inches.
      - 3) Members more than 2 feet deep: -1/4 inches, +1 inches.
    - d. Crosswise of members: Spaced evenly within +1 inches.
    - e. Lengthwise of members: +2 inches.
  3. Minimum clear distances between reinforcing bars:
    - a. Beams, walls and slabs: Distance equal to bar diameter or 1 inch, whichever is greater.
    - b. Columns: Distance equal to 1-1/2 times the bar diameter or 1-1/2 inches, whichever is greater.
    - c. Beam and slab reinforcing shall be threaded through the column vertical rebars without displacing the column vertical bars and still maintaining the clear distances required for the beam and slab reinforcing bars.
- B. Minimum concrete protective covering for reinforcement: As shown on Drawings.
- C. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
  1. For reinforcing: Class B splice meeting the requirements of ACI 318.
  2. For welded wire reinforcement:
    - a. Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than one spacing of cross wires plus 2 inches, nor less than 1.5 x development length nor less than 6 inches.
    - b. Development length shall be as required for the yield strength of the welded wire reinforcement in accordance with ACI 318.
  3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer.
    - a. Mechanical proprietary splice connectors may only be used when approved or indicated on the Contract Drawings.
- D. Welding:
  1. Welding reinforcing is not permitted.
- E. Placing Reinforcing:
  1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that may affect or reduce bond.
  2. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample is not less than required by applicable ASTM specification that governs for the reinforcing supplied.
  3. Reinforcing support:
    - a. Uncoated reinforcing:
      - 1) Support reinforcing and fasten together to prevent displacement by construction operations.

- a) Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - b) Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
  - c) Reinforcement shown on the Contract Documents may not be repositioned for use as a support for reinforcement. Additional drop bars may be provided for support of reinforcing.
- 2) Reinforcing supported on ground:
  - a) Slab on grade and other members with only one mat of reinforcing:
    - (1) Provide metal bar supports with bottom plate.
    - (2) Do not use concrete blocks to support slab-on-grade reinforcing.
  - b) All other members: Provide supporting concrete blocks or metal bar supports with bottom plate.
- 3) Reinforcing supported on formwork:
  - a) Concrete surfaces in contact with or over process liquid: All-Plastic chairs, runners and bar supports.
  - b) All other formed surfaces:
    - (1) Provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other reinforcing support.
    - (2) Only tips in contact with the forms need to be plastic coated.
- 4. Support reinforcing over cardboard void forms by means of concrete supports which will not puncture or damage the void forms during construction nor impair the strength of the concrete members in any way.
- 5. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, bars in the upper layers shall be placed directly above bars in the bottom layer with clear distance between layers to be 1 inch.
  - a. Place spacer bars at 3 feet maximum centers to maintain the required 1 inch clear distance between layers.
- 6. Extend reinforcement to within 2 inches of concrete perimeter edges.
  - a. If perimeter edge is formed by earth, extend reinforcement to within 3 inches of the edge.
- 7. To assure proper placement, furnish templates for all column vertical bars and dowels.
- 8. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer.
  - a. Do not bend reinforcing by means of heat.
- 9. Do not tack weld reinforcing.
- 10. Embed reinforcing into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation:
  - a. See Specification Section 03 15 19.

### **3.2 FIELD QUALITY CONTROL**

- A. Reinforcement Congestion and Interferences:
  - 1. Notify Engineer whenever the specified clearances between bars cannot be met.
  - 2. Do not place any concrete until the Engineer submits a solution to reinforcing congestion problem.
  - 3. Reinforcing may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
  - 4. If bars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of reinforcing.
  - 5. No cutting of reinforcing shall be done without written approval of Engineer.
- B. Special Inspection:
  - 1. See Section 01 45 33.
  - 2. See Section 03 05 05.

**END OF SECTION**

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**SECTION 03 31 30**  
**CONCRETE MATERIALS AND PROPORTIONING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Requirements for concrete materials, including:
    - a. Materials, including various types of grout, admixtures, cement, sand, aggregate, and other materials.
    - b. Concrete strength and proportioning, including design mixes for:
      - 1) Normal weight concrete.
      - 2) Mass concrete
      - 3) Grout.
- B. Scope:
1. Unless shown or indicated otherwise in the Contract Documents, concrete Work shall comply with:
    - a. ACI 301.
    - b. Laws and Regulations, including applicable building code.
  2. In this Section, material is apportioned into the following grouting types:
    - a. Base plates for columns and equipment.
    - b. As otherwise shown or indicated in the Contract Documents.
  3. This Section addresses materials for concrete. Other Specifications sections present other requirements for complete concrete Work, including, but not necessarily limited to:
    - a. Section 03 05 05 - Concrete Testing and Inspection.
    - b. Section 03 11 13 - Formwork.
    - c. Section 03 21 00 - Reinforcement.
    - d. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
    - e. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
    - f. Others as indicated in the Contract Documents.
- C. Related Requirements: Include but are not necessarily limited to:
1. Section 03 05 05 - Concrete Testing and Inspection.
  2. Section 03 15 19 - Anchorage to Concrete.
  3. Section 03 21 00 - Reinforcement.
  4. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
  5. Section 03 41 33 - Precast and Prestressed Concrete.

**1.2 REFERENCES**

- A. Abbreviations and Terminology:
1. Abbreviations: The following abbreviations are used in this Section:
    - a. "AAR" means deleterious "alkali-aggregate reaction", resulting from either alkali-silica reactive (ASR) or alkali-carbonate reactive (ACR) aggregates.
    - b. "SCM" means "supplementary cementitious materials", with the meaning indicated below.
    - c. "CLSM" means controlled low strength material in accordance with requirements of this Section.
  2. Terminology: Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this Section have the meanings indicated below:
    - a. "Supplementary cementitious materials" (SCM) means fly ash, silica fume, and GGBFS.
    - b. "Water-bearing concrete" is concrete surface to be in contact (whether continuously or intermittently) with water, process liquid, or slurries during intended operation of the

facility, including, but not limited to, concrete tanks, channels, wet wells, distribution chambers, and secondary containment structures.

- c. Independent Laboratory:
  - 1) Testing shall be performed by an independent laboratory complying with requirements of the generally recognized accrediting entity for the jurisdiction where the Site is located.
  - 2) Testing laboratory shall obtain all concrete samples and waterproofing product samples from the manufacturer of the associated product or material.

**B. Reference Standards:**

- 1. American Concrete Institute (ACI):
  - a. CT-13, Concrete Terminology.
  - b. 117, Specification for Tolerances for Concrete Construction and Materials
  - c. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
  - d. 212.3R, Chemical Admixtures for Concrete.
  - e. 232.2R, Use of Fly Ash in Concrete.
  - f. 301, Specifications for Structural Concrete for Buildings
- 2. ASTM International (ASTM):
  - a. C33, Standard Specification for Concrete Aggregates.
  - b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
  - d. C125, Terminology Relating to Concrete and Concrete Aggregates
  - e. C150, Standard Specification for Portland Cement.
  - f. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete.
  - g. C192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
  - h. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
  - i. C494, Standard Specification for Chemical Admixtures for Concrete.
  - j. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
  - k. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
  - l. C1116, Standard Specification for Fiber-Reinforced Concrete.
  - m. C1399, Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete.
  - n. C1609, Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading).
  - o. C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
  - p. C1778, Standard Guide for Reducing Risk of Deleterious Alkali-Aggregate Reaction in Concrete
- 3. Steel Deck Institute (SDI):
  - a. Design Manual for Composite Decks, Form Decks and Roof Decks.

### **1.3 SUBMITTALS**

**A. Action Submittals: Submit the following:**

- 1. Shop Drawings:
  - a. Schedule (table) of concrete materials proposed, listed by each specified grouping of concrete Work, including, but not limited to, aggregates, sand, cement (by type), SCM, admixtures, synthetic fibers, grouts, and other materials. For each separate material and product, indicate manufacturer and type of material.
  - b. Mix Designs:



- 1) Proposed mix design for each concrete grouping required. For each, indicate concrete designation (type) indicated in the Contract Documents, proposed materials and proportioning, and intended special uses, such as concrete intended for placement in cold weather or warm weather, concrete to be placed by pumping, concrete intended for specific locations in the Work, and others.
  - 2) Engineer's approval of mix design Shop Drawing is only for limited purposes indicated in the Contract Documents, including the General Conditions, and in no way reduces or mitigates Contractor's responsibility for construction means, methods, techniques, procedures, and sequences.
2. Product Data:
- a. Written affidavit stating materials proposed comply with requirements of reference standards indicated in this Section and, where applicable, compliance with state department of transportation standard specifications for highway and bridge construction in the jurisdiction of the Site. Clearly indicate specific reference standards and department of transportation standard specifications item designation applicable to each specific material.
  - b. For aggregate and sand, indicate source (quarry) and gradation of materials proposed for use. Indicate the specific concrete mix design(s) proposed for each.
  - c. For cement and SCM, indicate material source and submit manufacturer's technical data (except safety data sheets).
  - d. For each proposed admixture and type of grout material (including non-shrink grouts, epoxy grout, and grout cure/seal compound), submit manufacturer's published technical data (except safety data sheets).
- B. Informational Submittals: Submit the following:
1. Certifications: Submit concurrent with, but separate from, associated Shop Drawings and product data Submittals:
    - a. Certification of standard deviation, in units of pounds per square inch, for ready mix plant furnishing concrete.
    - b. SCM: Certification that SCM complies with quality requirements of this Section, and SCM Supplier's certified test reports for each shipment of SCM delivered to concrete Supplier.
    - c. ASTM C33: Certification that class of coarse aggregate complies with ASTM C33 for type and location of concrete Work.
    - d. Aggregate:
      - 1) Certification of aggregate gradation.
      - 2) Certification of coarse aggregate impurities relative to alkali-aggregate reactivity in accordance with ASTM C1778.
    - e. Certification of shrinkage test results.
  2. Test Reports:
    - a. Cement and SCM mill certificates for all materials to be supplied.
    - b. Test results for AAR impurities of coarse aggregates within proposed mixes, in accordance with ASTM standards cited in this Section.
  3. Supplier's Instructions: Submit concurrent with, but separate from, associated product data Submittals:
    - a. Manufacturer's written instructions on proper storage, handling, mixing, and use of materials furnished.

## 1.4 DELIVERY, STORAGE AND HANDLING

- A. Storage of Materials:
1. Admixtures:
    - a. Store admixtures in manner that avoids contamination, evaporation, and damage.
    - b. For admixtures used in form of suspensions or non-stable solutions, perform agitating as recommended by manufacturer to ensure uniform distribution of ingredients.

- c. Protect liquid admixtures from freezing and temperature changes that adversely affect admixture characteristics and performance.
- 2. Cement and SCM:
  - a. Store cement and SCM in containers in weathertight space that prevent contamination with moisture and other contaminants.
- 3. Aggregates:
  - a. Store and access aggregates in manner avoiding excessive segregation and preventing contamination with other materials and other sizes of like aggregate.
  - b. Do not use frozen or partially frozen aggregate.
- 4. Sand: Allow natural sand to drain until sand has relatively uniform moisture content, prior to use.
- 5. If stockpiled materials contact the ground, unless such materials are stored on a clean, firm, reasonably impervious surface such as concrete or asphalt paving, do not use in the concrete Work bottom six inches of stockpiled materials.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Cement:
  - 1. Provide ASTM C150 ASTM C595, Type I, I/II, or IL cement, unless otherwise required by the Contract Documents.
  - 2. Cement type provided shall match cement type used in associated approved mix design.
- B. SCM:
  - 1. Fly Ash:
    - a. ASTM C618, Class F or Class C.
    - b. Non-staining.
    - c. Appropriate for providing hardened concrete of uniform, light-gray color.
    - d. Compatible with all other concrete ingredients. Fly ash shall have no deleterious effect on hardened concrete Work.
    - e. Produced by source approved, by state department of transportation in the same jurisdiction as the Site, for use in concrete for highway bridges.
    - f. Evaluate and use in accordance with ACI 232.2R.
  - 2. SCM type used shall match SCM type used in associated approved mix design.
- C. Admixtures:
  - 1. Admixtures – General:
    - a. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in mix design approved by Engineer.
    - b. Provide admixtures certified by manufacturers as compatible with other admixtures proposed.
  - 2. Air Entraining Admixtures: Comply with ASTM C260.
  - 3. Water Reducing Admixtures:
    - a. Provide water-reducing admixtures in all concrete mixes to provide and maintain required water-to-cement ratio without additional cement.
    - b. Water Reducing, Retarding and Accelerating: Comply with ASTM C494 Types A through E, and ACI 212.3R.
    - c. High Range Water Reducers (Superplasticizers):
      - 1) Required for pumped concrete.
      - 2) Comply with ASTM C494 Types F and G.
  - 4. Hydration Stabilizer:
    - a. Comply with ASTM C494 Type D.
  - 5. Admixture Chlorides – General:
    - a. Provide chloride-free admixtures.
    - b. Do not use calcium chloride.

D. Crystalline Cementitious Waterproofing:

1. Products and Manufacturers: Subject to compliance with the Contract Documents, the following are acceptable.
  - a. Xypex Chemical Corporation, Bio-San C500.
  - b. Kryton International Inc, Krystol Internal Membrane (KIM).
  - c. Euclid Chemical Company, Eucon Vandex AM-10.
  - d. Or equal
2. Description: Factory blended dry powder compound consisting of Portland cement, treated aggregate, and active chemicals.
3. Dosage rate shall be not less than two percent by weight of cementitious materials or additional as necessary to comply with the performance requirements indicated below.
4. Required Locations: Provide crystalline cementitious waterproofing admixture in concrete as follows: all water bearing concrete.
5. Performance Criteria:
  - a. Mix waterproofing material in proportions recommended by manufacturer.
  - b. Submit to Engineer, together with product data Submittal, results of tests (previously performed for manufacturer) by independent third-party testing entity.
  - c. : Crystalline cementitious waterproofing material, identical to that proposed for use in the Work, shall have been tested in accordance with the following:
    - 1) DIN 1048/ EN 12390, Water Impermeability of Concrete:
      - a) Prepare and test untreated samples (“control samples”) and treated samples, all of the same concrete mix design. Test not less than three control samples and three treated samples.
      - b) Each sample shall be not less than 120 mm thick.
      - c) Subject samples to test pressure of water not less than design hydrostatic pressure to which concrete will be subject after Substantial Completion, for test duration of not less than 72 hours. However, test duration and pressure shall be sufficient for control samples to have not less than 100 mm of water penetration (average for all control samples tested).
      - d) Treated samples shall demonstrate not less than 90 percent reduction in depth of water penetration (average of all treated samples tested compared with average of all untreated control samples tested).
    - 2) Permeability: Supplier shall retain independent testing entity to perform permeability testing in accordance with USCOE CRD-C48 - Mod Permeability of Concrete.
      - a) Test samples of concrete, of identical mix design, using mix design similar to that used for the Work. Test untreated samples (“control samples”) and samples treated with the admixture.
      - b) Samples shall each be not greater than two inches thick.
      - c) Subject samples to water at test pressure of 150 psi.
      - d) When compared with control samples, the treated samples shall exhibit no measurable leakage. Control samples shall exhibit full saturation and measurable leakage.

E. Water:

1. Potable in accordance with Laws and Regulations.
2. Clean and free from deleterious substances.
3. Free of oils, acids, and organic matter. Comply with ASTM C1602.

F. Aggregates for Normal Weight Concrete:

1. Comply with ASTM C33.
2. Fine aggregates and coarse aggregates are separate ingredients.
3. Provide aggregates acceptable for bridge construction in accordance with the third-party standard specifications indicated below in this provision.
4. Blended aggregates are unacceptable
5. Coarse Aggregate:

- a. Material shall be well-graded, washed aggregate, free of organic material, material designation of the title of third-party standard specifications and name of entity.
  - b. Gradation: In accordance with Table 03 31 30-A in this section's "Mixes" Article.
- 6. Alkali-Reactive Aggregates:
  - a. Aggregates that may be deleteriously reactive, when combined with alkalis in cement, are unacceptable.
  - b. Evaluate proposed aggregates for potential deleterious alkali-aggregate reaction in concrete in accordance with ASTM C1778.
    - 1) Submit to Engineer results of source quality control testing for alkali-aggregate reactivity presenting the following:
      - a) Analysis and classification of aggregates in accordance with ASTM C1778
      - b) Results of source quality control analysis of aggregates.
      - c) Include the flow from Figure 1 of ASTM C 1778 indicating test results sequence.
      - d) Field performance history alone shall not be submitted to document acceptable aggregate performance.
      - e) Size and exposure condition of the Work in Table 2 of ASTM C 1778: humid, buried, or immersed.
      - f) Structure class for use in Table 3 of ASTM C1778: Class SC3.
- G. Maximum total water-soluble chloride ion content for concrete mix including all ingredients measured as weight percent of cement in accordance with ASTM C1218:
  - 1. Prestressed concrete: 0.06.
  - 2. All other concrete: 0.10.
- H. Non-shrink Grout:
  - 1. Manufacturers and Products: Subject to compliance with the contract Documents, the following are acceptable:
    - a. Master Builders Solutions, Masterflow, 713.
    - b. Euclid Chemical Company, NS Grout.
    - c. Sika, Sika Grout 212.
    - d. Sauereisen, F-100 Level Fill Grout.
    - e. Laticrete.
    - f. Or equal.
  - 2. Description:
    - a. This provision requires non-shrink, non-metallic grout. Unless otherwise shown or indicated in the Contract Documents, references to "non-shrink grout" refer to non-shrink, non-metallic grout required by this provision.
  - 3. Performance Criteria:
    - a. Non-shrink grout shall produce a positive but controlled expansion.
    - b. Mass expansion shall not be created by gas liberation or by other means.
    - c. Minimum 28-day Compressive Strength: 7,000 PSI.
  - 4. Material:
    - a. Provide material that is non-shrink, non-metallic, non-corrosive, and non-staining.
    - b. Comply with ASTM C1107, Grade B.
    - c. Premixed with water only. Add water in accordance with manufacturer's written instructions.
- I. Epoxy Grout:
  - 1. Manufacturers and Products: Subject to compliance with the Contract Documents, the following are acceptable:
    - a. Master Builders Solutions, Masterflow 648.
    - b. Five Star Products, DP Five Start Epoxy Grout.
    - c. Euclid Chemical Company, E3 Flowable.
    - d. Sika, Sikadur 42, Grout Pak.
    - e. Or equal.

- f. One manufacturer shall furnish both aggregate and adhesive.
- 2. Description:
  - a. Three-component epoxy resin system, comprised of two liquid epoxy components and one inert aggregate filler component.
  - b. Indication of locations where epoxy grout is required are indicated in the grout schedule in Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
  - c. Furnish each component in separate package for mixing at the Site.
- 3. Performance Criteria:
  - a. Minimum 28-day Compressive Strength: 13,000 PSI.
- 4. Materials:
  - a. Aggregate shall be compatible with adhesive.

## 2.2 MIXES

- A. Mixes - General:
  - 1. Provide concrete capable of: (a) being placed without segregation of aggregate from other components, and (b) developing all properties necessary and required.
  - 2. Provide ready-mix concrete in accordance with ASTM C94/C94M.
  - 3. Batching and other tolerances shall be in accordance with ACI 117.
  - 4. All concrete shall be normal weight concrete, unless otherwise required by the Contract Documents. Normal weight concrete shall weigh approximately 145 to 150 pounds per cubic foot (without reinforcing steel), measured 28 days after placing.
- B. Concrete Mixes:
  - 1. Mix design requirements are indicated in this Section's Table 03 31 30-A, below.
- C. Air Entrainment:
  - 1. Provide air entrainment in concrete providing total air content, expressed as percent by volume, in accordance with this Section's Table 03 31 30-A, below.
  - 2. Adjust dosage rate as necessary to compensate for shrinkage reducing admixtures and concrete placing method.
- D. Slump:
  - 1. Slump – General:
    - a. Measure slump at point of discharge of wet concrete into final location.
    - b. Compensate for slump loss due to placing method.
    - c. Concrete with slump less than minimum required may be used provided such concrete can be properly placed and consolidated.
    - d. Slump of Concrete to be Placed by Pumping:
      - 1) Provide water or water-reducing admixture at ready-mix plant for concrete to be placed by pumping, to allow for slump loss due to pumping.
      - 2) Provide additional water sufficient only so that slump of concrete at discharge end of pump hose does not exceed: (a) maximum allowable slump indicated, and (b) maximum specified water-to-cement ratio.
    - e. Slump Adjustment at the Site:
      - 1) Slump may be adjusted at the Site by providing water reducers.
      - 2) Dosing shall be performed by experienced quality control technician employed by concrete Supplier. Concrete mixing thereafter shall be directed by the same technician.
    - f. Slump tolerances shall comply with ACI 117.
  - 2. Concrete for Walls and Columns:
    - a. 8 inches maximum; 4 inches minimum.
    - b. Slump shall be obtained by use of mid-range or high-range water reducer complying with ASTM C494.
  - 3. All Other Members:
    - a. Concrete using water reducer in accordance with ASTM C494: 8 inches maximum; 4 inches minimum.

- b. Concrete without water reducer in accordance with ASTM C494: 5 inches maximum, one inch minimum.
- E. Proportioning:
  - 1. Proportioning – General:
    - a. Proportion components of concrete to provide mixture that can be placed: (a) into corners and angles of forms, and around reinforcing, by placing and consolidation methods employed, (b) without component materials becoming segregated, and (c) without excessive, free water to collecting on concrete surface or other surfaces.
    - b. Proportion component elements of concrete to provide proper concrete Work, including concrete durability, strength, and other necessary and required properties.
  - 2. Normal Weight Concrete:
    - a. Normal weight concrete target cementitious materials contents and maximum water to-cementitious ratios shall be in accordance with this Section's Table 03 31 30-A, below.
    - b. Target cementitious materials contents indicated in the Contract Documents are intended to provide crack-free, durable, finished concrete Work, rather than concrete Work of excessive strength.
  - 3. Water-Reducing, Water-Retarding, and Water-Accelerating Admixtures:
    - a. Provide in accordance with admixture manufacturer's written instructions.
    - b. Add to mix at ready-mix plant.
    - c. Use hydration stabilizer admixture, or AAR-inhibiting admixture, in concrete, as necessary and required, for placing and workability.
      - 1) Water reducers are required to maintain required maximum water-to-cement ratios.
  - 4. High Range Water Reducers (Superplasticizers):
    - a. Superplasticizers are required in:
      - 1) Concrete to be pumped, except slabs-on-grade and mats.
      - 2) Concrete for water-bearing structures.
      - 3) Other concrete Work at Contractor's option.
    - b. Maximum concrete slump, before addition of admixture, shall be three inches. Maximum slump after addition of superplasticizer admixture shall be eight inches.
    - c. Comply with Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing, relative to superplasticizers.
  - 5. Normal Weight Concrete Mix Proportioning:
    - a. Method 1:
      - 1) Use Method 1 when combination of concrete component materials and mixes will be evaluated and selected via trial-and-error.
      - 2) Provide mixes with suitable proportions and properties in accordance with ACI 211.1, using not less than three different water-to-cementitious ratios providing a range of concrete compressive strengths, including required average compressive strength.
      - 3) Trial mixes shall have slump within 0.75 inches of maximum allowed in the Contract Documents. For air-entrained concrete, air content of trial batches shall be within 0.5 percent of air entrainment required by the Contract Documents.
      - 4) For each water-to-cementitious ratio:
        - a) Provide not less than three trial compressive strength tests for concrete test age required, and cure in accordance with ASTM C192.
        - b) Cylinder Size: In accordance with ASTM C31.
        - c) Test for compressive strength at 28 days, in accordance with ASTM C39.
          - (1) Quantity of cylinders shall comply with one of the following trial strength test:
            - (a) 6-inch diameter cylinders: Two.
            - (b) 4-inch diameter cylinders: Three.
      - 5) From results of such required tests, plot curve showing relationship between water-to-cementitious ratio and compressive strength.

- 6) Based on required curve, select water-to-cementitious ratio for the Work, that will provide concrete of required average compressive strength.
  - 7) Provide cementitious content and mixture proportions so maximum water cement ratio is not exceeded when slump is equal to maximum allowed in the Contract Documents.
  - 8) Required average compressive strength is indicated below in this Section.
- b. Method 2:
- 1) In lieu of trial mixes required by Method 1, field test results from prior projects, for concrete made using identical or substantively identical concrete component materials and proportioning, may be used by concrete supplier in determining proposed mix proportions, provided the test results are within a year of project start date.
  - 2) Use of proposed concrete mix proportions based on field test results from prior projects are subject to approval by Engineer. Engineer's decision will be based on information in such Submittals and demonstrated ability, of such concrete successfully provided on such prior projects, to provide required average compressive strength.
  - 3) Requirements for Submittals of Concrete Test Results from Prior Projects:
    - a) Submittals of field test results from prior projects shall clearly indicate all materials, proportions, and conditions, and clearly indicate where such matters are similar to those required for the concrete Work on the Project.
    - b) Changes in the materials, proportions, and conditions within submitted test results from prior projects shall have been not more restricted than those for the subject, proposed concrete mix.
    - c) Field test reports from prior projects shall be in accordance with ACI 301 Article 4.2.3.
  - 4) Concrete proportions for the concrete Work may be determined from test results of prior projects via interpolation (by Contractor and concrete Supplier) between compressive strengths and proportions of two or more test results from prior projects, each in accordance with requirements of the Contract Documents for this Project.
6. Required average compressive strength shall exceed required 28-day compressive strength by the extent determined in accordance with ACI 318, Chapter 5 using the standard deviation of concrete ready-mix plant proposed for the Work as described in ACI 318, Chapter 5.
- F. Flowable Fill:
1. Provide mixture of cement, SCM, fine sand, water, and air, with consistency allowing flow under a very low pressure (low head).
  2. Approximate quantities of each component per cubic yard of mixed material:
    - a. Cement (Type I or Type II): 50 pounds.
    - b. SCM: 200 pounds.
    - c. Fine Sand: 2,700 pounds.
    - d. Water (approximate): 420 pounds.
    - e. Air Content (approximate): 10 percent.
  3. Adjust actual quantities to provide yield of one cubic yard with materials used.
  4. Approximate compressive strength shall be 85 to 175 psi.
  5. Sand Gradation: Fine sand shall be evenly graded material with not less than 95 percent passing No. 4 sieve and not more than five percent passing No. 200 sieve.
- G. Allowable Shrinkage:
1. Provide in accordance with Table 03 31 30-A of this Section, tested in accordance with ASTM C157 at 28 days.
  2. Continue testing for 64 weeks in accordance with ASTM C157 and submit results to Engineer as Informational Submittals.

3. Perform for concrete Work for all water bearing or basement structures unless expressly indicated otherwise in the Contract Documents.

TABLE 03 31 30-A							
Type of Concrete	28-day Compressive Strength	Max. W/C Ratio	Target Total Cement (pounds)	SCM	ASTM C33 Size No.	Air Content (%)	Allowable Shrinkage Limit
Normal weight lean concrete	3000 PSI	0.45	517	Note 1	7	5.5 to 8	NA
Normal weight concrete fill utility encasement concrete	3000 PSI	0.45	517	Note 1	57	4.5 to 7.5	NA
Normal weight precast concrete	5000 PSI	0.42	611		57	4.5 to 7.5	NA
Normal weight concrete w/ power trowel finish	4000 PSI	0.45	564	Note 1	57	0 to 2	0.048 percent
Normal weight water-bearing concrete	4500 PSI	0.40	564	Note 1	57 Note 267	4.5 to 7.5	0.032 percent
Normal weight all other concrete	4000 PSI	0.45	564	Note 1	57	4.5 to 7.5	0.048 percent

Table 03 31 30-A Notes:

1. If fly ash or GGBFS is proposed for use, the weight of fly ash or GGBFS plus weight of Portland cement shall be used to comply with total target cement content.
2. Unless otherwise indicated, larger aggregate (No. 467) is required for concrete slabs or foundations on grade; optional elsewhere

## 2.3 SOURCE QUALITY CONTROL

### A. Tests and Inspections at Production Facility:

1. Other provisions of this Section's "Part 2 – Products" indicate various tests and inspections required for materials to be incorporated into the concrete Work.
2. Refer to this Section's "Field Quality Control" Article for requirements regarding locations of samples for testing aggregates and other stockpiled materials to be incorporated into the concrete Work.

## PART 3 - EXECUTION

### 3.1 FIELD QUALITY CONTROL

#### A. Field Testing and Inspections:

1. Code-Required Tests and Special Inspections:
  - a. Section 01 45 33 - Code-Required Special Inspection Procedures, indicates testing scope for code-required testing and special inspections by testing entity retained by Owner or entity for whom Owner is responsible.
  - b. Section 03 05 05 - Concrete Testing and Inspection, indicates required testing for concrete Work.
2. Contractor-Performed Field Testing and Inspections:
  - a. Where concrete testing and inspection is required by the Contract Documents and is not part of the code-required tests and special inspections by Owner or other entity for whom Owner is responsible, such tests and inspections shall be by Contractor.
  - b. Perform concrete testing and inspections in accordance with Section 03 05 05 - Concrete Testing and Inspection.



- c. Aggregates and Other Stockpiled Materials: To ensure stockpiles at the concrete mixing location are not contaminated and otherwise comply with Contract requirements, perform tests on such materials at the concrete ready-mix plant.
- d. Perform strength test on all concrete to which water or superplasticizer, above the amount stated in concrete mix design Submittal approved by Engineer, has been added.
  - 1) Perform sampling after water or superplasticizer has been added and additional mixing has been performed.

**END OF SECTION**

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**SECTION 03 31 31**  
**CONCRETE MIXING, PLACING, JOINTING, AND CURING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Mixing, placing, jointing, and curing of concrete construction.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 01 45 33 – Special Inspections and Testing Program.
  - 2. Section 03 05 05 - Concrete Testing and Inspection.
  - 3. Section 03 11 13 - Formwork.
  - 4. Section 03 21 00 - Reinforcement.
  - 5. Section 03 31 30 - Concrete, Materials and Proportioning.
  - 6. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
  - 7. Section 07 92 00 - Joint Sealants.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Concrete Institute (ACI):
    - a. CT-13, Concrete Terminology.
    - b. 117, Specification for Tolerances for Concrete Construction and Materials.
    - c. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
    - d. 304.2R, Placing Concrete by Pumping Methods.
    - e. 305R, Guide to Hot Weather Concreting.
    - f. 305.1, Specification for Hot Weather Concreting.
    - g. 306R, Guide to Cold Weather Concreting.
    - h. 306.1, Standard Specification for Cold Weather Concreting.
    - i. 308.1, Specification for Curing Concrete.
    - j. 309R, Guide for Consolidation of Concrete.
    - k. 318, Building Code Requirements for Structural Concrete and Commentary.
    - l. 360R, Guide to Design of Slabs-on-Ground.
  - 2. ASTM International (ASTM):
    - a. C94/C94M, Standard Specification for Ready-Mixed Concrete.
    - b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - c. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
    - d. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
    - e. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
    - f. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - 3. Corps of Engineers (COE):
    - a. CRD-C572, Specifications for Polyvinylchloride Waterstop.
  - 4. National Ready Mixed Concrete Association (NRMCA):
    - a. Checklist for Certification of Ready Mixed Concrete Production Facilities.
- B. Qualifications:
  - 1. Ready Mixed Concrete Batch Plant: Certified by NRMCA.

2. Waterstop manufacturer's representative shall provide on-site training of waterstop installation, field splicing, welding and inspection procedures prior to construction, and at no additional cost to Owner.

### **1.3 DEFINITIONS**

- A. Words and terms used in this Specification Section are defined in ACI CT-13.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
      - 1) Procedure for adding high-range water reducer at the jobsite.
    - c. Scaled (minimum 1/8 inches per foot) drawings showing proposed locations of construction joints, control joints, expansion joints (as applicable) and joint profile dimensions for each joint type.
    - d. Manufacturers and types:
      - 1) Joint fillers.
      - 2) Curing agents.
      - 3) Construction joint bonding adhesive.
      - 4) Pressure relief valves.
      - 5) Waterstops.
  2. Certifications:
    - a. Ready mix concrete plant certification.
- B. Informational Submittals:
  1. Copies of concrete delivery tickets.
  2. Description of proposed curing methods.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Concrete Delivery:
  1. Prepare a delivery ticket for each load of ready mixed concrete.
  2. Truck operator shall hand ticket to Contractor at the time of delivery.
  3. Ticket to show:
    - a. Mix identification.
    - b. Quantity delivered.
    - c. Amount of material in each batch.
    - d. Outdoor temperature in the shade.
    - e. Time at which cement was added.
    - f. Time of delivery.
    - g. Time of discharge.
    - h. Amount of water that may be added at the site without exceeding the specified water-cement ratio.
    - i. Amount of any approved water added at the site.

### **1.6 PROJECT CONDITIONS**

- A. Adjust concrete mix design when material characteristics, job conditions, weather, strength test results or other circumstances warrant.
  1. Do not use revised concrete mixes until submitted to and approved by Engineer.

### **1.7 SEQUENCING AND SCHEDULING**

- A. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
  1. Approval of concrete mix design does not relieve Contractor of his responsibility to provide concrete that meets the requirements of the Contract Documents.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in this article are acceptable.
- B. Neoprene Expansion Joint Fillers:
  - 1. Acceptable manufacturers:
    - a. Permaglaze.
    - b. Rubatex.
    - c. Williams Products.
  - 2. Materials:
    - a. Closed cell neoprene.
    - b. ASTM D1056, Type 2, Class A or C.
    - c. Grade: Compression deflection as required to limit deflection to 25% of joint thickness under pressure from concrete pour height.
- C. Asphalt Expansion Joint Fillers:
  - 1. Acceptable manufacturers:
    - a. W.R Meadows.
    - b. J and P Petroleum Products.
  - 2. Materials: ASTM D994.
- D. Fiber Expansion Joint Fillers:
  - 1. Materials: ASTM D1751.
- E. Waterstops, PVC Type:
  - 1. Acceptable manufacturers:
    - a. Sika Greenstreak Plastic Products.
    - b. W.R Meadows.
    - c. Vinylex Corporation.
    - d. Bometals, Inc.
  - 2. Materials:
    - a. Virgin polyvinyl chloride compound not containing any scrap or reclaimed materials or pigment.
    - b. Cast-in-place type: COE CRD-572.
  - 3. Approved profiles as listed.
    - a. Construction joints:
      - 1) Ribbed: 6 inches wide by 3/8 inches.
      - 2) Sika Greenstreak Plastic Products Style #679, or equal.
    - b. Control joints:
      - 1) 6 inches wide by 3/8 inches thick with ribs and center bulb.
      - 2) Sika Greenstreak Plastic Products Style #705, or equal.
    - c. Expansion joint:
      - 1) 9 inches wide by 3/8 inches thick center bulb 2 inch OD.
      - 2) Sika Greenstreak Plastic Products Style #739, or equal.
  - 4. Provide factory-made waterstop fabrications at all changes in direction, intersections and transitions, leaving only straight butt splices for the field. Butt welds to be a minimum 6 inches clear of the intersection.
  - 5. Factory prepunched (less than 18 inches centers, each edge, staggered) for wire supports.
    - a. Provide hog rings or grommets at all punched holes along the length of the waterstop.
  - 6. See Drawings for application and other requirements.
- F. Waterstops, Preformed Strip Type:
  - 1. Acceptable manufacturers:
    - a. Sika Greenstreak Plastics, Inc. (Hydrotite).
    - b. Adeka Ultra Seal USA (MC-2010MN).

- c. DeNeef (Swellseal 2010).
  - 2. Hydrophilic, non-bentonite composition.
  - 3. Manufactured solely for the purpose of preventing water from traveling through construction joints.
  - 4. Volumetric expansion limited to 3 times maximum.
  - 5. See Drawings for application and other requirements.
- G. Water Swelling Sealant:
- 1. Required adhesive for use with strip-type waterstop.
  - 2. Compatible with strip-type waterstop.
  - 3. Single component, gun applied.
  - 4. Moisture cured.
  - 5. Minimum 70% volumetric expansion swelling capability.
- H. Curing Products to conform to one or more of the following:
- 1. Absorbent Covers.
  - 2. Moisture Retaining Covers.
    - a. Moisture Retaining Fabric.
  - 3. Dissipating curing compound:
    - a. Fugitive dye, waterborne, membrane-forming.
    - b. ASTM C309, Type 1D, Class A or B, shall be composed of hydrocarbon resins, and dissipating agents that begin to break down upon exposure to UV light, and traffic, approximately four to six weeks after applications, providing a film that is removable with standard degreasing agents, and mechanized scrubbing actions so as to not impair the later addition and performance of applied finishes.
    - c. Acceptable Products:
      - 1) Dayton Superior Corporation; Day Chem Rez Cure (J-11-WD).
      - 2) Euclid Chemical Company (The); Kurez DR VOX.
      - 3) L&M Construction Chemicals, Inc.; L&M Cure R.
  - 4. Clear, water -borne, membrane-forming curing and sealing compound:
    - a. ASTM C1315, Type 1, Class A.
    - b. Moisture loss shall be not more than 0.40 kg/M<sup>2</sup> when applied at 300 square feet/GAL.
    - c. Manufacturer's certification is required.
    - d. Subject to project requirements, provide one of the following products:
    - e. Products:
      - 1) Euclid Chemical Company; Super Diamond Clear, Luster Seal 300 (exterior), Super Rez-Seal (interior).
      - 2) L&M Construction Chemicals, Inc.; Lumiseal Plus.
      - 3) Meadows, W.R., Inc.; CS-309/30.
      - 4) Euclid Chemical Company; Super Diamond Clear VOX.
      - 5) L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
      - 6) Meadows, W.R., Inc.; Vocomp-30.
- I. Vapor Retarder: See Specification Section 07 26 00.
- J. Sand cement grout, non-shrink grout and epoxy grout: See Specification Section 03 31 30 for this non-structural material and use.

## 2.2 SOURCE QUALITY CONTROL

- A. The concrete plant shall conform to the Checklist for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. General:

1. All materials and construction shall conform to the tolerances as specified in ACI 117.
  2. Complete formwork.
    - a. See Specification Section 03 11 13.
  3. Remove earth, snow, ice, water, and other extraneous/foreign materials from areas that will receive concrete.
  4. Secure reinforcement in place.
    - a. See Specification Section 03 21 00.
  5. Position expansion joint material, anchors and other embedded items.
  6. Obtain approval of formwork, reinforcement installation and placement prior to placing concrete.
  7. Do not place concrete during rain, sleet, or snow, unless adequate protection is provided and prior Engineer approval is obtained.
    - a. Plan size of crews with due regard for effects of concrete temperature and atmospheric conditions on rate of hardening of concrete as required to obtain good surfaces and avoid unplanned cold joints.
    - b. Do not allow rainwater to increase mixing water nor to damage surface finish.
  8. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment and formwork.
  9. Provide slabs and beams of minimum indicated required depth when sloping structural foundation base slabs and elevated slabs to drains.
    - a. For floor slabs on grade, slope top of subgrade to provide slab of required uniform thickness.
- B. Preparation of Subgrade for Slabs On Ground:
1. Granular subgrade to be wetted without standing water immediately prior to placing concrete.
  2. Obtain approval of granular subgrade compaction density prior to placing slabs on ground.
- C. Edge Forms and Screeds:
1. Set accurately to produce designated elevations and contours of finished surface.
  2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
  3. Use strike off templates, or approved vibrating type screeds, to align concrete surfaces to contours of screed strips.

### 3.2 CONCRETE MIXING

- A. General:
1. Provide all concrete from a central plant conforming to Checklist for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.
  2. Batch, mix, and transport in accordance with ASTM C94/C94M.
- B. Control of Admixtures:
1. Control at the batch plant:
    - a. All admixtures to be introduced at the batch plant in accordance with manufacturer's recommendations.
    - b. Charge admixtures into mixer as solutions.
      - 1) Measure by means of an approved mechanical dispensing device.
      - 2) Liquid considered a part of mixing water.
      - 3) Admixtures that cannot be added in solution may be weighed or measured by volume if so recommended by manufacturer.
    - c. Add separately, when two or more admixtures are used in concrete, to avoid possible interaction that might interfere with efficiency of either admixture, or adversely affect concrete.
    - d. Complete addition of retarding admixtures within one minute after addition of water to cement has been completed, or prior to beginning of last three quarters of required mixing, whichever occurs first.
  2. Control of Admixtures in the field:

- a. Additional quantities of admixtures (with the exception of retarders) may be added in the field provided:
    - 1) Addition of admixtures shall be under the supervision of the ready-mix quality control representative.
    - 2) Addition of each admixture to be documented on the delivery ticket.
    - 3) Provide additional mixing per ASTM C94.
- C. Tempering and Control of Mixing Water:
  - 1. Mix concrete only in quantities for immediate use.
  - 2. Discard concrete which has set.
  - 3. Discharge concrete from ready mix trucks within time limit stated in ASTM C94.
  - 4. Addition of water at the jobsite:
    - a. See Specification Section 03 31 30 for specified water cement ratio and slump.
    - b. Do not exceed maximum specified water cement ratio or slump.
    - c. Incorporate water by additional mixing equal to at least half of total mixing required.

### **3.3 PLACING OF CONCRETE**

- A. General:
  - 1. Place concrete as such a rate that concrete, which is being integrated with fresh concrete, is still workable.
    - a. Select placement equipment and manpower in order to assure timely delivery of concrete into forms to avoid unintended cold joints and placement consolidation issues.
  - 2. Comply with ACI 304R and ACI 304.2R.
  - 3. Do not begin placing concrete during rain, sleet, or snow.
    - a. Protect fresh concrete from ensuing inclement weather.
  - 4. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
  - 5. Begin work only when work of other trades affecting concrete is complete.
  - 6. Do not use excess grout or mortar to lubricate lines when pumping concrete.
  - 7. Do not use excess water for workability or any reason when placing concrete by freefall.
  - 8. Deposit concrete continuously to avoid cold joints.
  - 9. Locate construction joints at locations specified or approved by Engineer.
    - a. Plan size of crews with due regard for effects of concrete temperature and atmosphere conditions to avoid unplanned cold joints.
  - 10. Spreaders:
    - a. Temporary: Remove as soon as concrete placing renders their function unnecessary.
    - b. Embedded:
      - 1) Obtain approval of Engineer for their use.
      - 2) Materials: Concrete or metal.
      - 3) Ends of metal spreaders coated with plastic coating 2 inches from each end.
  - 11. Deposit concrete as nearly as practicable in its final position to avoid segregation.
    - a. Maximum free fall: 4 feet.
    - b. Place concrete by means of hopper, elephant trunk or tremie pipe extending down to within 4 feet of surface.
  - 12. Perform the following operations before bleeding water has an opportunity to collect on surface:
    - a. Spread.
    - b. Consolidate.
    - c. Straightedge.
    - d. Darby or bull float.
  - 13. No water shall be added to the concrete surface to ease finishing operation.
  - 14. Do not discharge water into forms.
  - 15. Consider use of form vibrators for certain placement situations.
- B. Cold Weather Concrete Placement:
  - 1. Comply with ACI 306.1.



2. Do not place concrete on forms or subgrades that are below 32 degrees F or contain frozen material.
  3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete will come in contact with free of frost, ice or snow at time of concrete placement.
  4. Temperature of concrete when discharged at site: Per ACI 306.1.
  5. Heat subgrade forms, embedments and reinforcement to between 45 and 70 degrees F, when temperature of surrounding air is 40 degrees F or below at time concrete is placed.
    - a. Remove all frost from subgrade, forms and reinforcement before concrete is placed.
  6. Combine water with aggregate in mixer before cement is added, if water or aggregate is heated above 90 degrees F.
  7. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 90 degrees F.
  8. Follow ACI 306R for specific requirements dealing with elevated steel troweled slabs that will be exposed to freeze-thaw cycles.
- C. Hot Weather Concrete Placement:
1. Comply with ACI 305.1.
  2. Cool ingredients before mixing, or add flake ice or well crushed ice of a size that will melt completely during mixing for all or part of mixing water if high temperature, low slump, flash set, cold joints, or shrinkage cracks are encountered.
  3. Temperature of concrete at point of delivery (i.e. truck discharge) when placed:
    - a. Not to exceed 90 degrees F.
    - b. Not so high as to cause:
      - 1) Shrinkage cracks.
      - 2) Difficulty in placement due to loss of slump.
      - 3) Flash set.
  4. Temperature of forms and reinforcing when placing concrete:
    - a. Not to exceed 90 degrees F.
    - b. May be reduced by spraying with water to cool below 90 degrees F.
      - 1) Leave no standing water to contact concrete being placed.
  5. Prevent plastic shrinkage cracking and/or slab curling due to evaporation.
- D. Consolidating:
1. Consolidate in accordance with ACI 309R except as modified herein.
  2. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items and into corners of forms.
    - a. Ensure no displacement of reinforcing or other embeds from final position.
    - b. Eliminate:
      - 1) Air or stone pockets.
      - 2) Honeycombing or pitting.
      - 3) Planes of weakness.
  3. Use suitable form vibrators located just below top surface of concrete, where internal vibrators cannot be used in areas of congested reinforcing.
    - a. Size and coordinate external vibrators to specifically match forming system used.
  4. Internal vibrators:
    - a. Minimum frequency of 8000 vibrations per minute.
    - b. Insert and withdraw at points approximately 18 inches apart.
      - 1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient to cause segregation.
    - c. Use in:
      - 1) Beams and girders of framed slabs.
      - 2) Columns and walls.
      - 3) Vibrating concrete around all waterstops.
    - d. Size of vibrators shall be in accordance with ACI 309R, Table 5.1.5.
  5. Obtain consolidation of slabs with internal vibrators, vibrating screeds, roller pipe screeds, or other approved means.

6. Do not use vibrators to transport concrete within forms.
  7. When placing self-consolidating concrete, the use of form or pencil vibrators is acceptable, provided such methods do not cause aggregate segregation, or otherwise adversely affect the quality of the work.
  8. Provide sufficient spare vibrators on jobsite during all concrete placing operations to assure continuous vibration.
  9. Bring a full surface of mortar against form by vibration supplemented if necessary by spading to work coarse aggregate back from formed surface, where concrete is to have an as-cast finish.
  10. Prevent construction equipment, construction operations, and personnel from introducing vibrations into freshly placed concrete after the concrete has been placed and consolidated.
- E. Handle concrete from mixer to place of final deposit by methods which will prevent segregation or loss of ingredients and in a manner which will assure that required quality of concrete is maintained.
1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94.
  2. Horizontal belt conveyors:
    - a. Mount at a slope which will not cause segregation or loss of ingredients.
    - b. Protect concrete against undue drying or rise in temperature.
    - c. Use an arrangement at discharge end to prevent segregation.
    - d. Do not allow mortar to adhere to return length of belt.
    - e. Discharge conveyor runs into equipment specially designed for spreading concrete.
  3. Metal or metal lined chutes:
    - a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.
    - b. Chutes more than 20 feet long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.
    - c. Provide end of each chute with a device to prevent segregation.
  4. Pumping or pneumatic conveying equipment:
    - a. Designed for concrete application and having adequate pumping capacity.
    - b. Control pneumatic placement so segregation is avoided in discharged concrete.
    - c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 IN.
    - d. Do not convey concrete through pipe made of aluminum or aluminum alloy.
    - e. Provide pumping equipment without Y sections.

### **3.4 JOINTS AND EMBEDDED ITEMS**

- A. Construction Joints - General:
1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
    - a. Where construction joint spacing shown on Drawings exceeds the joint spacing indicated in Paragraph B. below, submit proposed construction joint location in conformance with this Specification Section.
  2. Unplanned construction joints will not be allowed.
    - a. If concrete cannot be completely placed between planned construction joints, then it must be removed.
  3. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
  4. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
  5. Provide the following joints unless noted otherwise on Drawings:
    - a. Roughen joints: horizontal construction joints.
    - b. Keyed joints: vertical construction joints.
  6. Roughen construction joints:
    - a. Clean the previously hardened concrete interface and remove all laitance.

- b. Intentionally roughen the interface to a full amplitude of 1/4 inches.
  - 7. Minimum time before placement of adjoining concrete construction:
    - a. All concrete: 60 hours, unless otherwise noted.
- B. Construction Joints - Spacing Unless Otherwise Specified:
  - 1. Structures not intended to contain liquid:
    - a. Wall vertical construction joints:
      - 1) 50 feet maximum centers.
      - 2) At wall intersections, 4 feet minimum from corner.
    - b. Base slab, floor, and roof slab construction joints:
      - 1) Placements to be approximately square and not to exceed 2500 SQFT.
      - 2) Maximum side dimension of a slab pour to be 70 feet.
  - 2. Water retaining structures:
    - a. Wall vertical construction joints:
      - 1) 30 feet maximum centers.
      - 2) At wall intersections, 6 feet minimum from corner.
    - b. Wall horizontal construction joints: 18 feet centers.
    - c. Floor slab, construction joints:
      - 1) Placements to be approximately square and not to exceed 2000 SQFT.
      - 2) Maximum side dimension of a slab pour to be less than:
        - a) Twice the length of the short side.
        - b) 60 feet.
- C. Construction Joints - Bonding:
  - 1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints.
  - 2. Before new concrete is placed, all construction joints shall be coated with cement grout, or dampened, as outlined below:
  - 3. Roughen construction joints:
    - a. Roughen the surface of the concrete to expose the coarse aggregate uniformly with 1/4 IN minimum amplitude.
      - 1) Remove laitance, loosened particles of aggregate or damaged concrete at the surface.
  - 4. Keyed construction joints:
    - a. Thoroughly clean construction joints and remove all laitance.
    - b. Dampen the hardened concrete immediately prior to placing of fresh concrete.
- D. Slab On Grade Joints:
  - 1. Locate construction and control joints in slabs on grade as indicated on Drawings.
  - 2. Time cutting properly with set of concrete, if saw cut joints are required or permitted.
    - a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw.
    - b. Complete before shrinkage stresses become sufficient to produce cracking.
- E. Expansion Joints:
  - 1. Do not permit reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.
  - 2. Use neoprene expansion joint fillers, unless noted otherwise on Drawings.
  - 3. Seal expansion joints as shown on Drawings.
    - a. See Specification Section 07 92 00 for requirements.
- F. Waterstops - General:
  - 1. Waterstop to be continuous with splices in accordance with manufacturer's instructions and create water tight joints.
  - 2. Do not mix different types of waterstop materials in the same structure without specific approval from the Engineer unless shown on Drawings.

3. Preformed strip type:
    - a. Locate waterstop at center of wall, unless noted otherwise on Drawings.
      - 1) Maintain at least 3 inches from edge of concrete or as recommended by manufacturer.
    - b. Install in a bed of swelling sealant on smooth surface of hardened concrete by use of nails, adhesive or other means as recommended by manufacturer to prevent movement of waterstop during placement of concrete.
    - c. Roughened joints shall be especially prepared during concrete placement to provide smooth surface for proper water stop installation.
    - d. Use in joints against existing concrete where indicated on Drawings.
  4. PVC waterstops:
    - a. Pre-position waterstop accurately in joints, with adequate clearance from all reinforcing. Do not push waterstop into wet concrete.
    - b. Secure waterstops in correct position using hog rings or grommets spaced no more than 18 inches maximum staggered along each edge full length and passed through the edge of the waterstop.
      - 1) Tie wire to adjacent reinforcing.
    - c. Hold horizontal waterstops in place with continuous supports.
    - d. Install according to manufacturer's instructions.
      - 1) Do not displace reinforcement from required location.
    - e. Splice ends and intersections with perpendicular butt splice using electrical splicing iron in accordance with manufacturer's instructions.
      - 1) Use factory fabricated "T" and corner intersection fittings.
      - 2) Field splice straight runs of material.
    - f. Unless otherwise noted, use for all construction joints in new construction for all structures indicated on Drawings.
- G. Pressure Relief Valves and Screens:
1. Provide and install 4 inches ID pressure relief valves in locations shown on the Drawings.
  2. Place valves in true vertical position (90 degrees from the true horizontal plane).
  3. Place screens immediately upon granular material and under pressure relief valves as shown on Contract Drawings.
    - a. Leave no space between valves, screen, and granular material.
- H. Other Embedded Items:
1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to initiating concreting.
    - a. Give Contractor whose work is related or integral to concrete, or supported by it, ample notice and opportunity to furnish and install items before placing concrete.
  2. Do not route electrical conduit, drains, or pipes in concrete slabs, walls, columns, foundations, beams or other structural members unless approved by Engineer.
- I. Placing Embedded Items:
1. Support against displacement.
  2. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
  3. Provide adequate means for anchoring waterstop in concrete.
    - a. Provide means to prevent waterstops in the forms from being folded over by the concrete as it is placed.

### **3.5 FINISHING**

- A. See Specification Section 03 35 00.
- B. Coordinate mixing and placing with finishing.

### **3.6 INSTALLATION OF GROUT**

- A. Grout Schedule:

1. Non-shrinking non-metallic grout:
    - a. Filling form tie holes.
    - b. Under column and beam base plates.
    - c. Other uses indicated on the Drawings.
  2. Epoxy grout:
    - a. Patching cavities in concrete.
    - b. Grouting of dowels and anchor bolts into existing concrete.
    - c. Grouting of rotating or oscillating equipment base plates.
    - d. As noted on the Drawings.
- B. Grout Installation:
1. Non-shrink non-metallic grout:
    - a. Clean concrete surface to receive grout.
    - b. Saturate concrete with water for 24 hours prior to grouting.
    - c. Mix in a mechanical mixer.
    - d. Use no more water than necessary to produce flowable grout.
    - e. Place in accordance with manufacturer's instructions.
    - f. Provide under beam, column, and equipment base plates, in joints between precast concrete and cast slabs, and in other locations indicated on the Drawings.
    - g. Completely fill all spaces and cavities below the top of base plates.
    - h. Provide forms where base plates and bed plates do not confine grout.
    - i. Where exposed to view, finish grout edges smooth.
    - j. Except where a slope is indicated on the Drawings, finish edges flush at the base plate, bed plate, member or piece of equipment.
    - k. Coat exposed edges of grout with cure or seal compound recommended by the grout manufacturer.
  2. Epoxy grout:
    - a. Mix and place in accordance with manufacturer's instructions.
    - b. Apply only to clean, dry, sound surface.
    - c. Completely fill all cavities and spaces around dowels and anchors without voids.
    - d. Grout base and bed plates as specified for non-shrinking, non-metallic grout.
    - e. Obtain manufacturer's field technical assistance as required to assure proper placement.

### 3.7 CURING AND PROTECTION

- A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain.
  1. Follow recommendations of ACI 308.1 except as modified herein.
  2. Do not impose loads by foot traffic, wheeled traffic, and other loads until concrete has sufficiently cured to carry imposed loads without adversely affecting the concrete. In no event shall concrete be subject to loading or traffic during initial 48 hours of curing, unless otherwise approved by Engineer.
- B. Apply one of the following curing procedures immediately after completion of placement and finishing (surfaces not in contact with forms).
  1. Ponding or continuous sprinkling. Take care to avoid eroding the surface of freshly placed concrete.
  2. Application of wet Absorbent Covers:
    - a. Minimum lap: 12 inches.
    - b. Provide continuous uniform supply of moisture, such as sprinklers or soaker hoses as required to keep concrete surface continuously wet.
    - c. Monitor Absorbent Covers as required to prevent cover materials or concrete surface from drying out.
  3. Continuous application of steam (not exceeding 150 degrees F) or mist spray.
  4. Application of Moisture Retaining Cover sheet materials.

- a. Place as soon as possible after final finishing and without marring the surface.
  - b. Minimum lap: 12 inches.
  - c. Seal all edges to make water-tight.
  - d. Place Moisture Retaining Cover in intimate contact with the concrete surface, without wrinkles and weighted to hold in place.
  - e. Hold cover and edges in place as required to prevent wind from displacing the cover.
  - f. Moisture Retaining Fabric:
    - 1) Install in accordance with manufacturer's written recommendations.
    - 2) Saturate concrete surface and fabric side of cover immediately prior to placing.
  - g. Monitor continuously during the curing period:
    - 1) Repair any holes, tears or displaced cover.
    - 2) Rewet as required to keep concrete moist under cover.
  5. Application of other moisture retaining covering as approved by Engineer.
  6. Water used for curing shall be within 20 degrees F of the concrete temperature.
  7. Application of a curing compound.
    - a. Apply curing compound in accordance with manufacturer's recommendations immediately after any water sheen, which may develop after finishing, has disappeared from concrete surface.
    - b. Do not use on any surface against which additional concrete or other material is to be bonded unless it is proven that curing compound will not prevent bond.
    - c. Where a vertical surface is cured with a curing compound, the vertical surface shall be covered with a minimum of two coats of the curing compound.
      - 1) Apply the first coat of curing compound to a vertical surface immediately after form removal.
      - 2) The vertical concrete surface at the time of receiving the first coat shall be damp with no free water on the surface.
      - 3) Allow the preceding coat to completely dry prior to applying the next coat.
      - 4) A vertical surface: Any surface steeper than 1 vertical to 4 horizontal.
  8. Surfaces In Contact with Forms:
    - a. Formed surfaces: Cure formed concrete surfaces utilizing final curing methods per ACI 308.1, including underside of beams, supported slabs, and other similar surfaces,
      - 1) See Section 03 11 13.
    - b. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to heating by sun by keeping forms wet and cool until they can be safely removed.
    - c. Make provisions to keep concrete wall moist while stripping forms and until curing measures are in place.
    - d. After form removal, cure concrete until end of time prescribed.
    - e. Use one of the methods listed above.
    - f. Forms left in place shall not be used as a method of curing in hot weather.
    - g. The term "hot weather", where used in these specifications, is defined in ACI 305.1.
    - h. In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete.
- C. Curing Period:
1. Continue curing for at least seven days for all concrete except Type III, high early strength concrete for which period shall be at least three days.
    - a. If one of curing procedures indicated above is used initially, it may be replaced by one of other procedures indicated any time after concrete is two days old, provided concrete is not permitted to become surface dry during transition.
- D. Cold Weather:
1. Follow recommendations of ACI 306.1.
  2. Maintain temperature of concrete per ACI 306.1 for a minimum of 72 hours after concrete is placed, when outdoor temperature is 40 degrees F, or less.
    - a. Maximum temperature rate of decrease: Per ACI 306.1.

3. Use heating, covering, insulating, or housing of the concrete work to maintain required temperature without injury due to concentration of heat.
  4. Do not use combustion heaters unless precautions are taken to prevent exposure of concrete to exhaust gases which contain carbon dioxide.
  5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does not develop in the supporting subgrade.
- E. Hot Weather:
1. Follow recommendations of ACI 305.1 and ACI 308.1.
  2. Make provision for cooling forms, reinforcement and concrete, windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light-colored material.
  3. Provide protective measures as quickly as concrete hardening and finishing operations will allow.
  4. Maximum temperature rate of decrease: Per ACI 305.1.
- F. Rate of Temperature Change:
1. Keep changes in temperature of air immediately adjacent to concrete as uniform as possible, during and immediately following curing period.
- G. Protection from Mechanical Injury:
1. Protect concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration.
  2. Protect finished concrete surfaces from damage by construction equipment, materials, or methods, and by rain or running water.
  3. Do not load self-supporting structures in such a way as to overstress concrete.

### **3.8 FIELD QUALITY CONTROL**

- A. Special Inspections per building code:
1. See Section 01 45 33 and 03 05 05.

## **END OF SECTION**

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**SECTION 03 35 00**  
**CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Concrete finishing and repair of surface defects.
  - 2. Chemical Sealers.
  - 3. Polymer Modified Cementitious Coating.
  - 4. Resurfacing Mortar.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 11 13 - Formwork.
  - 2. Section 03 31 30 - Concrete, Materials and Proportioning.
  - 3. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Concrete Institute (ACI):
    - a. CT-13, Concrete Terminology.
    - b. 117, Specification for Tolerances for Concrete Construction and Materials.
    - c. 303R, Guide to Cast-in-Place Architectural Concrete Practice.
    - d. 308, Standard Practice for Curing Concrete.
  - 2. ASTM International (ASTM):
    - a. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).
    - b. C150, Standard Specification for Portland Cement.
    - c. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
    - d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - e. C666, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
    - f. C779, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
    - g. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
    - h. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
    - i. D4259, Standard Practice for Abrading Concrete.
    - j. E1155, Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers.
    - k. E1486, Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria.
  - 3. International Concrete Repair Institute (ICRI):
    - a. 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
  - 4. National Council Highway Research Program (NCHRP):
    - a. 244, Concrete Sealers for the Protection of Bridge Structures.

The Society for Protective Coatings (SSPC) merged with NACE in 2020 to form the Association for Materials Protection and Performance (AMPP). For now, they are keeping the standards titles with the former respective association titles (e.g. SSPC-SP6 or NACE No. 3). Standard titles will be updated in the future when AMPP announces title changes.

- 5. The Society for Protective Coatings/NACE International (SSPC/NACE):

- a. SP 13/NACE No. 6, Surface Preparation of Concrete.
- B. Qualifications:
  - 1. Chemical Sealer CS-2:
    - a. Applicator shall be factory trained and approved, in writing, by the manufacturer to apply the product.
    - b. Applicator shall have a minimum of five years of experience successfully applying materials specified.
- C. Mock-Ups.
  - 1. General:
    - a. Construct additional mock-ups as required until accepted.
    - b. Mock-ups constitute minimum standard of quality for actual construction.
    - c. Maintain mock-up during construction.
    - d. Remove when directed by Engineer.
  - 2. Construct mock-up for each type of wall finish specified for review and acceptance by Engineer.
    - a. Minimum 4 x 4 feet area for each different wall finish specified.
    - b. Mock-ups shall include:
      - 1) Sample of patched tie hole.
      - 2) Sample of all jointery being used in the walls.
    - c. Include mock-up of wall having polymer modified cementitious coating.
      - 1) Mock-up shall be stepped to show surface preparation, repairs and coating in all stages of application.
  - 3. Construct mock-up floor slab for review and acceptance by Engineer.
    - a. Minimum 10 x 10 feet.

### 1.3 DEFINITIONS

- A. Vertical Surface Defects:
  - 1. Any void in the face of the concrete deeper than 1/8 inches, such as:
    - a. Tie holes.
    - b. Air pockets (bug holes).
    - c. Honeycombs.
    - d. Rock holes.
  - 2. Scabbing:
    - a. Scabbing is defect in which parts of the form face, including release agent, adhere to concrete.
  - 3. Foreign material embedded in face of concrete.
  - 4. Fins 1/16 inches or more in height.
- B. Installer or Applicator:
  - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  - 2. Installer and applicator are synonymous.
- C. Other words and terms used in this Specification Section are defined in ACI CT-13.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  - 2. Certifications:
    - a. Certification of aggregate gradation.
    - b. Certification of manufacturer experience qualifications and performance history.
    - c. Certification of applicator's qualifications.
      - 1) Refer to Qualifications paragraph.

- 2) Provide manufacturer's written approval of applicators.
- 3) Provide references substantiating specialty experience.

B. Informational Submittals:

## **1.5 DELIVERY, STORAGE, AND HANDLING**

A. Comply with manufacturer's recommendations and requirements for materials used.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Bonding Agents:
  - a. Master Builders Solutions.
  - b. Euclid Chemical Co.
  - c. Laticrete - L&M Construction Chemicals.
2. Chemical Sealers:
  - a. Master Builders Solutions.
  - b. Euclid Chemical Co.
  - c. Laticrete - L&M Construction Chemicals.
  - d. Tnemec Chemprobe.
3. Polymer Modified Cementitious Coating:
  - a. Aquafin International.
  - b. Master Builders Solutions.
  - c. Euclid Chemical Co.
4. Patching Mortar:
  - a. Master Builders Solutions.
  - b. Euclid Chemical Co.
  - c. Laticrete - L&M Construction Chemicals.
  - d. Sika Corporation.

### **2.2 MATERIALS**

- A. Chemical Sealer CS-1:
  1. High solids, water-based solution containing acrylic copolymers.
    - a. ASTM C1315, Type I, Class A.
    - b. Non-yellowing UV resistant.
    - c. VOC Content: <200 G/L.
  2. USDA approved as a concrete floor sealer.
  3. Euclid Chemical Super Diamond Clear VOX.
- B. Chemical Sealer CS-2:
  1. Water based chemical solution containing a blend of silicate and siliconate polymers designed to seal, harden and dustproof concrete floors.
  2. VOC Content: 0 G/L.
  3. Performance of treated concrete floor:
    - a. Coefficient of Friction:
      - 1) Dry: 0.81.
      - 2) Wet: 0.72.
    - b. Liquid repellency, RILEM Method 11.4:
      - 1)  $\geq 1$  mL.
  4. Euclid Chemical Euco Diamond Hard.
- C. Chemical Sealer CS-3:
  1. Clear, penetrating, breathable, waterborne silane-siloxane solution.
  2. VOC content:  $\leq 50$  G/L.

3. Odorless.
  4. Flash point: >200 degrees F.
  5. Water absorption: 85% reduction per NCHRP 244.
  6. Chloride penetration: 82% reduction per NCHRP 244.
  7. Euclid Chemical Baracade WB 244.
- D. Patching Mortar: Trowelable cementitious repair mortar for vertical, overhead, and horizontal repairs.
1. Portland cement-based, rapid set repair mortar for interior or exterior use.
  2. Compressive Strength, ASTM C109:
    - a. Minimum 3000 psi at 7 days.
    - b. Minimum 5000 psi at 28 days.
  3. Freeze Thaw Durability, ASTM C666: 96.75% at 300 Cycles.
  4. Shrinkage, ASTM C157: 0.069%.
  5. Euclid Chemical Speed Crete Red Line.
- E. Bonding Agents:
1. For use only on concrete surfaces not receiving liquid water repellent coating:
    - a. High solids acrylic latex base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
      - 1) Master Builders MasterEmaco A 660.
      - 2) Euclid Chemical Co. Flex-Con.
      - 3) Laticrete L&M Everbond.
  2. For use only on concrete surface receiving liquid water repellent:
    - a. Non-acrylic base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
- F. Cement:
1. ASTM C150, Type II Portland for areas exposed to sewage.
  2. ASTM C150, Type I Portland elsewhere.
- G. Aggregate:
1. Sand: Maximum size #30 mesh sieve.
  2. For exposed aggregate finish surfaces: Same as surrounding wall.
- H. Water: Potable.
- I. Polymer modified cementitious coating:
1. Polymer modified Portland cement based coating for concrete and masonry.
    - a. Waterproof.
    - b. Resistant to both positive and negative hydrostatic pressure.
    - c. Breathable.
  2. Master Builders Solutions MasterSeal 581 or Euclid Chemical Tamoseal.
    - a. Color:
      - 1) Interior surfaces: Standard gray.
      - 2) Exterior surfaces: Standard gray.
    - b. Texture: Fine.
- J. Nonshrink Grout: See Specification Section 03 31 30 and Specification Section 03 31 31.

## 2.3 MIXES

- A. Bonding Grout: One part cement to one part aggregate.
- B. Patching Mortar:
1. One part cement to 2-1/2 parts aggregate by damp loose volume.
    - a. Substitute white Portland cement for a part of gray Portland cement to produce color matching surrounding concrete.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. For methods of curing, see Specification Section 03 31 31.
- B. Surface Preparation:
  - 1. Clean surfaces in accordance with ASTM D4258 to remove dust, dirt, form oil, grease, or other contaminants prior to abrasive blasting, chipping, grinding or wire brushing.
  - 2. Prepare surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
    - a. Provide concrete surface profile (CSP) in accordance with ICRI 310.2:
      - 1) Areas to receive Repair Mortar:
        - a) Areas larger than 1 SF or deeper than 1/4 inches Abrasive blast, scarify or needle scale to CSP No. 6-8.
      - b. If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
      - c. No feathered edges will be permitted.
      - d. Rinse surface with clean water to remove all dust, dirt, debris, loosened concrete, laitance, and other contaminants.
- C. Preparation of Bonding Grout Mixture:
  - 1. Mix cement and aggregate.
  - 2. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
  - 3. Add bonding agent/water mixture to cement/aggregate mixture.
  - 4. Mix to consistency of thick cream.
  - 5. Bonding agent itself may be used as bonding grout if approved by manufacturer and Engineer.
- D. Preparation of Patching Mortar Mixture:
  - 1. Mix specified patching mortar per manufacturer's published recommendations.
  - 2. For repairs exceeding 2 inches in depth, mix with clean, pre-dampened 3/8 inches pea gravel in accordance with the manufacturer's recommendations.
- E. Polymer modified cementitious coating:
  - 1. Mix in accordance with manufacturer's recommendations using bonding agent acceptable to coating manufacturer.

### **3.2 INSTALLATION AND APPLICATION**

- A. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected to be below 50 degrees F.
  - 1. If necessary, enclose and heat area to between 50 and 70 degrees F during repair of surface defects and curing of patching material.
    - a. Use only clean fuel, indirect fired heating apparatus.
    - b. Exhaust combustion byproducts outside of work area.
- B. Chemical Sealer Application:
  - 1. General:
    - a. Immediately prior to Substantial Completion, thoroughly clean floor in accordance with ASTM D4258 and prepare to receive chemical sealer.
      - 1) Remove previously applied membrane curing compounds.
      - 2) Remove soil, oils, stains, discoloration, or any other imperfection having a negative impact on the appearance of the finished floor.
    - b. Apply product to floor areas indicated on the Drawings.
    - c. Apply in accordance with manufacturer's published installation instructions.
  - 2. Chemical Sealer (CS-1):
    - a. Apply two uniform coats at rate recommended by manufacturer.

- 1) Apply using manufacturer's recommended equipment with a fan-tip nozzle.
    - 2) Do not allow material to puddle.
  - b. Allow first coat to completely dry before applying second coat.
  - c. Spotted or mottled appearances will not be accepted.
  3. Chemical Sealer (CS-2):
    - a. Apply two uniform coats at rate recommended by manufacturer.
      - 1) Scrub the material into the floor using a mechanical scrubber.
        - a) Keep the surface wet for not less than 30 minutes.
        - b) Continue scrubbing in accordance with manufacturer's application instructions.
        - c) After material has thickened, but not more than 60 minutes after application, remove all excess liquid.
      - 2) Thoroughly rinse with clean water to remove all residue.
        - a) Damp mop with clean water to remove any streaks.
        - b) Do not allow residue to dry on floor surface.
      - 3) Do not track material onto untreated surfaces.
    - b. After rinsing, allow floor to dry completely and apply second coat following the same procedures.
    - c. Final floor finish shall have uniform sheen without streaking, stains or white residue.
  4. Chemical Sealer (CS-3):
    - a. Apply uniform coats at rate recommended by manufacturer.
      - 1) Apply with fine, uniform spray or microfiber pad.
    - b. Allow floor to dry completely and remove any dried residue using hot water and mild citric acid.
    - c. Final floor finish shall be uniform, free of residue, and shall repel water.
    - d. Apply additional coat(s) as necessary to achieve water repellent finish.
- C. Repairing Surface Defects:
1. This method is to be used on vertical concrete surfaces as indicated in the Concrete Finishes for Vertical Wall Surfaces paragraph of this Specification Section and similar concrete surfaces not otherwise specified to receive another finish or coating.
    - a. For surfaces indicated to receive finish or coating other than those specified herein; refer to the applicable Specification Section for surface preparation requirements:
      - 1) High Performance Industrial Coatings: See Specification Section 09 96 00.
  2. Fill and repair surface defects and tie-holes using patching mortar mix specified in the MATERIALS Article in PART 2.
    - a. Prime exposed reinforcing steel, embeds or other steel surfaces with primer as recommended by patching mortar manufacturer.
    - b. Scrub bond coat:
      - 1) Wet substrate to a saturated surface dry (SSD) condition.
      - 2) Mix patching mortar to a scrub coat or slurry consistency per manufacturer's published recommendations and apply to entire area.
    - c. As an alternate to the scrub bond coat, concrete may be primed with manufacturer's recommended epoxy primer.
    - d. Patching Mortar Application:
      - 1) Mix and apply Patching Mortar per manufacturer's recommendations within the open time of the product scrub coat or any bonding agents.
      - 2) Finish to level of surrounding concrete surface utilizing techniques recommended by manufacturer.
  3. Consolidate patching mortar into place and strike off so as to leave patch slightly higher than surrounding surface.
  4. Leave undisturbed until mortar has stiffened before finishing level with surrounding surface.
    - a. Do not use steel tools in finishing a patch in a formed wall which will be exposed to view.
  5. Cure patching mortar in accordance with ACI 308.

D. Concrete Finishes for Vertical Wall Surfaces:

1. General:
  - a. Give concrete surfaces finish as specified below after removal of formwork and repair of surface defects.
  - b. Finish numbers not listed are "Not Used".
2. Finish #1 - As cast rough form finish:
  - a. Selected forming materials are not required.
  - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
  - c. Repair the following surface defects using patching mortar specified in PART 2:
    - 1) Tie holes.
    - 2) Honeycombs deeper than 1/4 inches.
    - 3) Air pockets deeper than 1/4 inches.
    - 4) Rock holes deeper than 1/4 inches.
  - d. Chip or rub off fins exceeding 1/4 inches in height.
  - e. Provide at unexposed surfaces such as:
    - 1) Foundations.
    - 2) Below-grade walls not to be waterproofed.
    - 3) Concealed surface of concrete back-up wythe in cavity wall construction.
3. Finish #2 - As cast form finish:
  - a. Form facing material shall produce a smooth, hard, uniform texture.
    - 1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.
  - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
    - 1) Chip or rub off fins exceeding 1/8 inches in height.
    - 2) Abrasive blast surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
      - a) Provide ICRI 310.2 Concrete Surface Profile (CSP) No. 3, minimum across the entire surface.
        - (1) For contiguous repair areas larger than 1 SF or deeper than 1/4 inches Abrasive blast, scarify or needle scale to CSP No. 6-8.
      - b) If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
      - c) No feather edges will be permitted.
    - 3) Rinse surface with clean water and allow surface water to evaporate prior to repairing surface defects.
    - 4) Repair the following surface defects using patching mortar specified in PART 2:
      - a) Tie holes.
      - b) Honeycombs deeper than 1/4 inches or larger than 1/4 inches diameter.
      - c) Air pockets deeper than 1/4 inches or larger than 1/4 inches diameter.
      - d) Rock holes deeper than 1/4 inches or larger than 1/4 inches diameter.
      - e) Scabbing.
    - 5) Brush blast repaired areas to match adjacent surface texture.
  - c. Provide this finish for:
    - 1) Underside of horizontal elements adjacent to the finished surface.
    - 2) Exposed surfaces not specified to receive another finish.
4. Finish #3 - Grout rubbed finish:
  - a. Provide this finish for:
5. Finish #4 - Polymer modified cementitious coating:
  - a. Form facing material shall produce a smooth, hard, uniform texture.
    - 1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.
    - 2) Comply with ACI 303R for formwork accuracy and form joint handling to prevent grout leakage.

- b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
    - 1) Chip or rub off fins exceeding 1/8 inches in height.
    - 2) Abrasive blast and repair surface defects in accordance with Concrete Finish #2.
  - c. Apply decorative coating to entire surface.
    - 1) As a mixing liquid for the coating, use bonding agent and water mixture as recommended by coating manufacturer.
    - 2) Apply two (2) coats at 2 pounds per square yard per coat.
      - a) During application of first coat, complete fill all voids, depressions or other surface imperfections.
  - d. When second coat is set, float to a uniform texture with a sponge float.
  - e. Construct mock-up per the Mock-Ups paragraph in the QUALITY ASSURANCE Article in PART 1 of this Specification Section.
- E. Related Unformed Surfaces (Except Slabs):
  - 1. Strike smooth and level tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
  - 2. Float surface to a texture consistent with that of formed surfaces.
    - a. If more than one finish occurs immediately adjacent to unformed surface, provide surface with most stringent formed surface requirement.
  - 3. Continue treatment uniformly across unformed surfaces.
- F. Concrete Finishes for Horizontal Slab Surfaces:
  - 1. General:
    - a. Tamp concrete to force coarse aggregate down from surface.
    - b. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains.
    - c. Dusting of surface with dry cement or sand during finishing processes not permitted.
  - 2. Unspecified slab finish:
    - a. When type of finish is not indicated, use following finishes as applicable:
      - 1) Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
      - 2) , except future floors, Floors: Troweled finish.
      - 3) Exterior slabs, sidewalks, platforms, steps and landings, and ramps, not covered by other finish materials: Broom or belt finish.
      - 4) Fish rearing tank slabs: Smooth trowel finish
      - 5) All slabs to receive a floated finish before final finishing.
  - 3. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.
  - 4. Floated finish:
    - a. After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, do no further work until ready for floating.
    - b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operations.
      - 1) Use wood or cork float.
    - c. During or after first floating, check planeness of entire surface with a 10 feet straightedge applied at not less than two different angles.
  - 5. Cut down all high spots and fill all low spots to produce a surface with Class B tolerance throughout.
    - a. Refloat slab immediately to a uniform texture.
  - 6. Troweled finish:
    - a. Float finish surface to true, even plane.
    - b. Power trowel, and finally hand trowel.
    - c. First troweling after power troweling shall produce a smooth surface which is relatively free of defects, but which may still show some trowel marks.
    - d. Perform additional trowelings by hand after surface has hardened sufficiently.



- e. Final trowel when a ringing sound is produced as trowel is moved over surface.
- f. Thoroughly consolidate surface by hand troweling.
- g. Finish in accordance with the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
  - 1) Leave finished surface essentially free of trowel marks, uniform in texture and appearance.
- h. On surfaces intended to support floor coverings, remove any defects that would show through floor covering.
- 7. Broom or belt finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom or burlap belt across surface.

### **3.3 FIELD QUALITY CONTROL**

- A. Tolerances:
  - 1. Finished floor slabs:
    - a. Provide Floor Flatness ( $F_F$ ) and Floor Levelness ( $F_L$ ) in accordance with ACI 117.
      - 1) Measure in accordance with ASTM E1155.
    - b. Slabs not indicated to be sloped:
      - 1)  $F_F$ : Equal or greater than 35.
      - 2)  $F_L$ : Equal or greater than 25.
    - c. Slabs indicated to be sloped or curved:
      - 1) Measure in accordance with ASTM E1486.
      - 2) Provide slopes or curves as indicated on the Drawings.
    - d. Slabs indicated to receive polished concrete floor:
      - 1)  $F_F$ : Equal or greater than 45.
      - 2)  $F_L$ : Equal or greater than 35.
      - 3) Refer to Room Finish Schedule on Drawings.
  - 2. Horizontal surfaces other than finished floor slabs, including but not limited to, top of footings, top of walls, concrete fill in tankage, channels and similar applications:
    - a. Gap between a 10 feet straightedge placed anywhere and the finished surface shall not exceed:
      - 1) Class A tolerance: 1/4 inches.
      - 2) Class B tolerance: 3/8 inches.
      - 3) Class C tolerance: 1/2 inches.
    - b. Accumulated deviation from intended true plane of finished surface shall not exceed 1/2 inches.
- B. Unacceptable finishes shall be replaced or, if approved in writing by Engineer, may be corrected provided strength and appearance are not adversely affected.
  - 1. High spots to be removed by grinding and/or low spots filled with a patching compound or other remedial measures to match adjacent surfaces.
- C. Provide services of manufacturer's technical representative:
  - 1. A certified manufacturer's representative experienced in the use of the products used shall be present on a full-time basis to observe and oversee all operations associated with the installation.
  - 2. Contractor, along with manufacturer, shall be fully responsible for the proper application, including all means and methods incidental thereto necessary for a sound, secure and complete installation.
  - 3. Manufacturer's representative shall be present for installation of:
    - a. Dry-shake Hardener.
    - b. Heavy-duty Metallic Aggregate Topping.

### **3.4 PROTECTION**

- A. All horizontal slab surfaces receiving chemical sealer shall be kept free of traffic and loads for minimum of 72 hours following installation of sealer.

### 3.5 CONCRETE FINISH SCHEDULE

DRAWING NO.	STRUCTURE NAME	SURFACE TO BE FINISHED	FINISH NO.

**END OF SECTION**

**SECTION 03 41 33**  
**PRECAST AND PRESTRESSED CONCRETE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Precast and prestressed concrete.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 05 05 - Testing.
  - 2. Section 03 21 00 - Reinforcement.
  - 3. Section 03 31 30 - Concrete, Materials and Proportioning.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Association of State Highway and Transportation Officials (AASHTO):
    - a. HB, Standard Specifications for Highway Bridges.
  - 2. American Concrete Institute (ACI):
    - a. 318, Building Code Requirements for Structural Concrete.
  - 3. ASTM International (ASTM):
    - a. A36, Standard Specification for Carbon Structural Steel.
    - b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
    - c. A416, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
    - d. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
    - e. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
    - f. C33, Standard Specification for Concrete Aggregates.
    - g. C150, Standard Specification for Portland Cement.
    - h. C330, Standard Specification for Lightweight Aggregates for Structural Concrete.
    - i. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
    - j. E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
  - 4. American Welding Society (AWS):
    - a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
    - b. A5.5/A5.5M, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.
    - c. D1.1, Structural Welding Code - Steel.
    - d. D1.4, Structural Welding Code - Reinforcing Steel.
    - e. D1.6, Structural Welding Code – Stainless Steel.
  - 5. Occupational Safety and Health Administration (OSHA).
  - 6. Precast/Prestressed Concrete Institute (PCI):
    - a. MNL 116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
    - b. MNL 120, Design Handbook - Precast and Prestressed Concrete.
- B. Qualifications:
  - 1. Provide precast and prestressed concrete units produced by an active member of PCI.
  - 2. Plant to be certified by the Precast/Prestressed Concrete Institute, Plant Certification Program, as applicable:
    - a. Certification Code C1: Precast Concrete Products.
    - b. Plant shall have been certified within past year from bid date.

3. Plant shall be certified by IAS and shall be acceptable to the Building Code Official to assure compliance with approved fabricator Special Inspection requirements in accordance with the building code.
  - a. Plants that are not certified by IAS or not acceptable to the Building Code Official may be acceptable to work on the Project, provided:
    - 1) Plant meets all remaining qualifications.
    - 2) Contractor reimburses the Owner the cost of Special Inspection services.
4. Provide units manufactured by plant which has regularly and continuously engaged in manufacture of units of same type as those required for a minimum of three years.
5. Assure manufacturer's testing facilities meet requirements of ASTM E329.
6. Welding operators and processes to be qualified in accordance with:
  - a. AWS D1.1 for welding steel shapes and plates.
  - b. AWS D1.4 for welding reinforcing bars.
7. Welding operators to have passed qualification tests for type of welding required during the previous 12 months prior to commencement of welding.
8. Engineer for all precast or prestressed members: Professional Engineer licensed in the State of Maine.
  - a. Engineer to have minimum five years of experience in design of precast and prestressed members with scope similar to this Project.
9. Precast erector:
  - a. Minimum three years of experience with projects of similar size and complexity.

### **1.3 DEFINITIONS**

- A. Slabs: May refer to hollow core slabs or solid flat slabs, prestressed or non-prestressed.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Sizes, types and manufacturer of bearing pads.
    - d. Hardware to be utilized to support suspended appurtenances.
  2. Shop Drawings and erection plans for precast units, their connections and supports showing:
    - a. Member size and location.
    - b. Size, configuration, location and quantity of reinforcing bars and prestressing strands.
    - c. Initial prestress forces.
    - d. Size and location of openings verified by Contractor.
    - e. Size, number, and locations of embedded metal items and connections.
    - f. Required concrete strengths.
    - g. Identification of each unit using same standard marking numbers as used to mark actual units.
  3. Calculations for members and connections designed by fabricator.
    - a. Calculations to be sealed by a professional Structural Engineer registered in the State in which the Project is constructed.
    - b. Perform calculations using the dead load of the members plus the superimposed uniform and concentrated loads shown on the Drawings and indicated in this Specification Section.
    - c. Indicate the following:
      - 1) Design for maximum moment, maximum shear and maximum torsion.
      - 2) Final top and bottom flexural stresses resulting from the stresses due to maximum moment and prestress force.
      - 3) Ultimate moment capacity.
      - 4) Final top and bottom flexural stresses, ultimate moment capacity, and ultimate shear capacity, if affected, for members with reduced cross sections due to openings or penetrations.

- 5) When required on Drawings, a check for no tension in top and bottom of members due to prestress force and member dead load plus superimposed loads indicated on Drawings and in this Specification Section.
- 6) Column design for maximum axial load and maximum moment.
4. Submit test results, when so required on Drawings, showing that embedded connection items will adequately support the indicated loads.
  - a. Connection items to have an ultimate load capacity of at least two times the required indicated load.
5. Concrete mix design(s) including submittal information defined in Specification Section 03 05 05.
6. Fabricator's quality control documentation for special inspections as required by the building code Chapter 17.
7. Copies of source quality control tests.
8. Certification of manufacturer's testing facility qualifications.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Headed studs and deformed bar anchors:
    - a. Nelson Stud Welding Div., TRW, Inc.
    - b. KSM Division, Omark Industries.
  2. Bearing pads:
    - a. JVI, Inc.

### **2.2 MATERIALS**

- A. Embedded Steel Plates and Shapes:
  1. ASTM A36.
- B. Cement:
  1. Comply with ASTM C150, Type I or III.
  2. Type II cement to be used in the following precast units:
    - a. Precast weir troughs.
- C. Aggregates for Normal Weight Concrete:
  1. ASTM C33 with coarse aggregate meeting the gradation for Size 67 as stated in ASTM C33.
  2. Provide aggregates approved for bridge construction by the State Highway Department in the state where the precast units are fabricated or in the state where the Project is located.
  3. All fine aggregate to be natural not manufactured.
- D. Water:
  1. Potable, clean.
  2. Free of oils, acids, and organic matter.
- E. Maximum total chloride ion content contributed from all ingredients of concrete including water, aggregates, cement and admixtures measured as a weight percent of cement to not exceed 0.06 for prestressed concrete and 0.10 for all other precast concrete.
- F. Prestressing Strands:
  1. Either 250K or 270K high tensile strength uncoated seven wire strand.
  2. Manufacture and test strands in accordance with ASTM A416.
- G. Reinforcing Steel and Welded Wire Reinforcement: See Specification Section 03 21 00.
- H. Headed Studs:
  1. ASTM A108.

2. Minimum yield strength: 50,000 psi.
3. Minimum tensile strength: 60,000 psi.
- I. Deformed Bar Anchors:
  1. ASTM A496 or ASTM A1064.
  2. Minimum tensile strength: 80,000 psi.
  3. Minimum yield strength: 70,000 psi.
- J. Electrodes:
  1. E70 series conforming to AWS A5.1/A5.1M or AWS A5.5/A5.5M for welding steel shapes and plates.
  2. E90 series conforming to AWS A5.5/A5.5M for welding rebar.

## **2.3 DESIGN**

- A. General Design Requirements:
  1. Design units and connections in strict accordance with ACI 318 and the PCI MNL 120.
  2. Design units for spans, dead load of members, dead and live loads indicated on the Drawings with concentrated loads placed in their actual locations.
    - a. Verify weights and locations of concentrated loads.
  3. Design units taking into account reduced cross section at openings and penetrations.
  4. Provide all reinforcing in units as indicated.
    - a. Where not indicated, design and provide all reinforcing and prestressing strands subject to approval of Engineer.

## **2.4 MIXES**

- A. See Specification Section 03 31 30.
- B. Do not begin fabrication of units until concrete mix design(s) have been approved by Engineer.

## **2.5 FABRICATION**

- A. Do not fabricate units until Shop Drawings have been approved by Engineer and returned to Contractor and support locations have been field verified by Contractor.
- B. Manufacture, quality, dimensional and erection tolerances of all units to be in accordance with both PCI MNL 116 and PCI MNL 120.
- C. Cast all members in smooth rigid forms which will provide straight, true members of uniform thickness and uniform color and finish.
- D. Use sand cement grout mixture to fill all air pockets and voids, and to repair chipped edges.
- E. Finish all repairs smooth and to match adjacent surface texture and color.
- F. Where units are to receive concrete topping, provide units having heavy broom finish on top surface for bond.
  1. Provide roughness of top surface to provide bond with topping and design for horizontal shear at topping and unit interface in accordance with requirements of ACI 318, Horizontal Shear Strength paragraph.
  2. Make all other surfaces smooth.
- G. Cast openings larger than 6 inches SQ or 6 inches diameter in units at time of manufacture.
  1. Make smaller openings by neat cutting or neat drilling by trades requiring them.
  2. Coordinate sizes and locations of all openings before fabrication of units.
- H. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.
- I. Minimum concrete compressive strength at time of strand release: 3500 psi.
- J. Mark each unit as indicated on the erection plans.
  1. Place mark on non-exposed-to-view surface.

- K. Coat or finish ends of exposed prestressing strands to prevent rusting.

## **2.6 SOURCE QUALITY CONTROL**

- A. During production of precast concrete units, conduct strength tests of concrete placed in units as required in Specification Section 03 05 05 for concrete placed during fabrication.
  - 1. Results of strength tests to be sent immediately to Engineer, Contractor and Owner.
  - 2. Test reports to indicate units they represent.
- B. When approved by Engineer, strength tests may be made by precast manufacturer after he has submitted certification that his testing facilities meet the requirements of ASTM E329.
- C. Conduct tests on precast concrete using the following procedures:
  - 1. If the precast manufacturer's quality control program requires more frequent or more stringent testing requirements, the manufacturer's quality control program will take precedence over the specific type of test.
    - a. Precast manufacturer to employ services of an independent testing laboratory to perform concrete testing for manufacturer's production procedures (not listed below) and quality control program.
  - 2. If the precast fabrication plant is not certified by IAS and acceptable to the Building Code Official, Owner will employ and pay for precast concrete production special inspection.
    - a. Coordinate with Owner's special inspector.
      - 1) Provide minimum 7 calendar days notice prior to the start of fabrication.
      - 2) Provide minimum 24 hours notice prior to fabrication of any precast members.
  - 3. If precast fabrication plant is certified by IAS and acceptable to the Building Code Official, perform concrete tests as specified in Section 03 05 05. Frequency of tests: Per PCI MNL-116 or PCI MNL-117 as applicable.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Verify acceptability and location of supports to receive units.
  - 1. Check bearing surfaces to determine that they are level and uniform.
- B. Verify compressive strengths of concrete and masonry supports.
  - 1. Do not start erection of units until supports have reached their 28 day required compressive strengths.

### **3.2 FIELD QUALITY CONTROL**

- A. Testing and Special Inspections: See Section 01 45 33.
- B. Causes for rejection of units include, but are not necessarily limited to the following:
  - 1. Cracked units.
  - 2. Chipped, broken, or spalled edges.
  - 3. Units not within allowable casting tolerances.
  - 4. Voids or air pockets which, in opinion of Engineer, are too numerous or too large.
  - 5. Non-uniform finish or appearance.
  - 6. Low concrete strength.
  - 7. Improperly placed embedded items and/or openings.
  - 8. Exposed wire mesh, reinforcing or prestressing strands.

## **END OF SECTION**

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# DIVISION 04

MASONRY



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**SECTION 04 01 20**  
**MASONRY CLEANING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Masonry cleaning.

**1.2 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Use experienced workmen familiar with product and its application.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Manufacturer's application instructions.
    - b. Manufacturer's dilution recommendations.
    - c. Manufacturer's recommendations on neutralizing rinse.
- B. Certifications:
  - 1. Certification that Contractor is experienced in this type of masonry cleaning.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Cleaning solution, detergent type:
    - a. PROSOCO, Inc.
    - b. Diedrich Technologies, Inc.
  - 2. Cleaning solution for manganese or vanadium stained masonry:
    - a. PROSOCO, Inc.
    - b. Diedrich Technologies, Inc.

**2.2 MATERIALS**

- A. Detergent-Type Cleaning Solution: PROSOCO, Inc. "Sure Klean #600 inches detergent masonry cleaner.
- B. Manganese or Vanadium-Stained Masonry: PROSOCO, Inc. "Vanatrol."
- C. Water: Potable.
- D. Neutralizing rinse as required by manufacturer.

**2.3 MIXES**

- A. Dilute cleaning solution with potable water at rate which will provide for the weakest solution allowable for cleaning wall.
- B. If project conditions require solution of greater than 5% acid, obtain permission from Engineer in writing prior to applying solution to wall surface.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Allow seven days after completion of masonry work before start of cleaning.
- B. Remove excess mortar using wooden paddles and scrapers.
- C. Protect adjacent surfaces not to be cleaned.

### **3.2 APPLICATION**

- A. Protect adjacent surfaces subject to potential damage by cleaning solution.
- B. Apply masonry cleaner to exposed-to-view masonry surfaces.
  - 1. Do not use wire brushes.
  - 2. Use only tools free of rust.
  - 3. Apply solution using fibered wall-washing brush.
- C. Thoroughly rinse and pre-soak walls.
- D. Flush all loose mortar and dirt from surface.
- E. Wet to prevent "run-off" streaking.
- F. Scrape off mortar and reapply cleaning solution.
- G. After scrubbing, clean thoroughly with pressurized water.
- H. Apply neutralizing rinse as recommended by manufacturer.

**END OF SECTION**

**SECTION 04 05 13**  
**MASONRY MORTAR AND GROUT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Masonry mortar.
  - 2. Masonry grout.
  - 3. Integral water repellent admixture.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 04 22 00 - Concrete Masonry.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
    - b. C144, Standard Specification for Aggregate for Masonry Mortar.
    - c. C150/C150M, Standard Specification for Portland Cement.
    - d. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
    - e. C270, Standard Specification for Mortar for Unit Masonry.
    - f. C404, Standard Specification for Aggregates for Masonry Grout.
    - g. C476, Standard Specification for Grout for Masonry.
    - h. C1019, Standard Test Method for Sampling and Testing Grout.
    - i. C1093, Standard Practice for Accreditation of Testing Agencies for Masonry.
    - j. C1384, Standard Specification for Admixtures for Masonry Mortars.
  - 2. The Masonry Society (TMS):
    - a. 602, Specification for Masonry Structures.
- B. Qualifications:
  - 1. Preconstruction Testing Laboratory shall be an independent agency qualified in accordance with ASTM C1093 for performing the testing indicated.
    - a. Testing Laboratory shall have a minimum of 10 years of experience in the testing of mortar and grout.
    - b. Technician conducting tests shall have minimum of five years of experience in the testing of mortar and grout.

**1.3 DEFINITIONS**

- A. Coarse grout and fine grout are defined by the aggregate size used in accordance with ASTM C476.
- B. Coarse aggregate and fine aggregate are defined in ASTM C404, Table 1.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. General:
      - 1) Product data for cementitious materials.
      - 2) Source or producer of aggregates and gradation.
      - 3) Integral water repellent manufacturer's dosage rate.
    - c. Proposed mortar mix design:
    - d. Proposed masonry grout mix design.

2. Test results:
  - a. Preconstruction mortar test results.
  - b. Preconstruction masonry grout test results.
- B. Informational Submittals:
  1. Qualifications of testing lab and technician.
  2. Test results and inspection reports per Specification Section 01 45 33.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location.
  1. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Deliver preblended, dry mixes in moisture-resistant containers.
  1. Store preblended, dry mixes in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Portland Cement:
  1. ASTM C150/C150M, Type I or II.
  2. No air entrainment.
  3. Natural color.
  4. Maximum percent of alkalis: 0.60 in accordance with ASTM C150/C150M, Table 2.
- B. Hydrated Lime:
  1. ASTM C207, Type S.
  2. Type SA not acceptable.
  3. Lime substitutes are not acceptable.
- C. Mortar Aggregate: ASTM C144, free of gypsum.
- D. Grout Aggregate: ASTM C404.
- E. Water: Potable.
- F. Integral Water Repellent Admixture:
  1. Liquid polymeric admixture: ASTM C1384.
  2. Verify compatibility with liquid water repellent admixture being used in the fabrication of concrete masonry units.

### **2.2 MIXES**

- A. Mortar and grout shall comply with TMS 602 and building code.
- B. Type "S" mortar shall be used:
  1. Comply with ASTM C270, Table No. 1, Cement-Lime Mortar.
    - a. Do not use masonry cement or mortar cement.
    - b. No fly ash additives will be accepted.
  2. Mix materials minimum of three minutes and maximum of five minutes.
  3. Adjust consistency to satisfaction of mason.
  4. Do not use admixtures unless otherwise indicated.
  5. Provide integral water repellent admixture in mortar used for:
    - a. Exterior concrete masonry work.
    - b. Interior concrete masonry work in wet areas.
  6. Do not use integral water repellent admixture in mortar for brick.

- C. Masonry Grout:
  - 1. ASTM C476.
    - a. Minimum 28-day compressive strength: 2,000 psi.
    - b. Slump: 8 to 11 inches.
  - 2. Mix 5 minutes minimum.
  - 3. No admixtures allowed.
  - 4. At Contractor's option, premixed or preblended grout meeting the above minimum requirements may be used.

## **2.3 SOURCE QUALITY CONTROL**

- A. Perform preconstruction laboratory tests on proposed masonry mortar and grout prior to start of masonry work.
  - 1. Perform tests far enough in advance so that any necessary retesting can be accomplished before masonry construction begins.
    - a. Test mortar per ASTM C270.
    - b. Test grout per ASTM C1019.
- B. Source Limitations for Mortar Materials:
  - 1. Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions and TMS 602.
- B. Mortar:
  - 1. If standard gray mortar begins to stiffen, it may be retempered by adding water and remixing unless prohibited by water repellent admixture manufacturer.
    - a. Standard gray mortar shall not be retempered more than one time.
  - 2. All mortar must be used within 2-1/2 hours maximum after initial mixing per TMS 602.
  - 3. Engineer reserves right to alter mix design based on initial rate of absorption of masonry units.
  - 4. Set Prefaced masonry using type S mortar.
    - a. Rake mortar from joint as recommended by the unit manufacturer.
    - b. Tuckpoint raked joints and scored joints using pointing grout.
      - 1) Install pointing grout in accordance with ANSI A108.10 and masonry unit manufacturer's published instructions.
      - 2) Use polymer modified sanded pointing grout for joints in:
        - a) Exterior masonry.
        - b) Interior dry areas.
      - 3) Use epoxy pointing grout for joints in interior areas subject to exposure to corrosive or caustic chemicals.
- C. Masonry Grout:
  - 1. Use grout within 1-1/2 hours maximum after initial mixing.
  - 2. Use no grout after it has begun to set.
  - 3. Do not retemper grout after initial mixing.
  - 4. Place grout in lifts not exceeding 4 feet.
  - 5. Use coarse grout in spaces with least dimension over 2 inches.
  - 6. Consolidate all grout while installing.
    - a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.

- b. Consolidate grout pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

### **3.2 FIELD QUALITY CONTROL**

- A. Masonry Mortar and Grout Testing and Inspection:
  - 1. Testing and inspection services will be provided by the Owner's special masonry inspector.
    - a. Do not include in the bid price the cost of these services.
  - 2. Testing and inspection shall include, but is not limited to:
    - a. Observe proportions of site-prepared mortar and grout.
    - b. Observe grout space prior to grouting.
    - c. Grout compressive strength sampling, testing and reporting per ASTM C1019.
      - 1) One strength test shall be the average of three specimens from the same sample, tested at 28 days.
    - d. Grout slump test sampling, testing, and reporting per ASTM C143/C143M.
    - e. Frequency of sampling: One sample (three specimens) collected each grouting operation during masonry construction.
  - 3. Reporting: Special inspector to submit test results and inspection reports per Specification Section 01 45 33.

### **END OF SECTION**



**SECTION 04 05 23**  
**MASONRY ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Masonry accessories.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 05 50 00 - Metal Fabrications.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - b. A951, Standard Specification for Steel Wire for Masonry Joint Reinforcement.
    - c. A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
    - d. A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
    - e. D412, Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
    - f. D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
    - g. D2000, Standard Classification System for Rubber Products in Automotive Applications.
    - h. D2240, Standard Test Method for Rubber Property—Durometer Hardness.
- B. Mock-Ups:
  - 1. Coordinate with built-in items and veneer coursing.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Detailed drawings of all factory or field formed stainless steel thru wall flashing.
    - d. Tear resistance of flashing material.
    - e. Manufacturer's recommendations for flashing adhesive.
    - f. Manufacturer's data sheet on each product.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Weep vents for cavity wall construction:
    - a. Heckman Building Products Inc.
    - b. Hohmann & Barnard, Inc.
    - c. Wire Bond.

- d. Mortar Net USA, Ltd.
- 2. Reglets:
  - a. Hohmann & Barnard, Inc.
  - b. Heckmann Building Products.
  - c. Superior Concrete Accessories, Inc.
- 3. Masonry anchors, horizontal joint reinforcing and miscellaneous anchors:
  - a. Heckman.
  - b. Hohmann & Barnard, Inc.
  - c. Wire Bond.
- 4. Thru wall flashing:
  - a. EPDM:
    - 1) Carlisle Syntech Systems, Inc.
    - 2) Holcim Elevate.
  - b. Stainless steel:
    - 1) Heckman Building Products.
    - 2) Hohmann & Barnard, Inc.
- 5. Weep joint mortar protection system:
  - a. Mortar Net USA, Ltd.
  - b. Hohmann & Barnard, Inc.
  - c. Wire Bond.
- 6. Preformed control joint inserts:
  - a. Hohmann & Barnard, Inc.
  - b. Wire Bond.
- 7. Grout screen:
  - a. Wire Bond.
  - b. Heckman Building Products.
  - c. Hohmann & Barnard, Inc.

## 2.2 MANUFACTURED UNITS

- A. Thru Wall Flashing:
  - 1. 40 mil EPDM manufactured specifically for thru wall flashing.
    - a. Tear resistance: ASTM D624, 150 pound/IN minimum.
    - b. Width as necessary.
      - 1) Provide single piece full width, no horizontal joints will be allowed unless approved in writing by Engineer.
    - c. Factory precut wherever possible.
    - d. Factory fabricated inside corners, outside corners, and end dams.
- B. Flashing Adhesive: As recommended by flashing manufacturer for sealing laps, sealing to vertical masonry and concrete surfaces and sealing to stainless steel surfaces.
- C. Weep Vent:
  - 1. 90% open mesh vent designed to be placed in vertical mortar joint.
  - 2. Mortar Net USA, Ltd. "Mortar Net Weep Vents."
  - 3. Color: Gray.
- D. Reglets:
  - 1. Products specified are manufactured by Hohmann & Barnard, Inc.
  - 2. For masonry construction: Type #MR - Masonry Reglet.
  - 3. For concrete construction: Type #CR - Concrete Reglet.
- E. Veneer Anchorage System for New Concrete Back-up:
  - 1. Anchors, dovetail:
    - a. Stainless steel, Type 304 or 316, ASTM A666.
    - b. 16 GA corrugated steel with dovetail.
      - 1) 1 inches wide x 5-1/2 inches long minimum or as necessary by Project conditions.
        - a) Provide minimum 2 inches embedment into veneer mortar joint.

2. Dovetail slots:
  - a. Stainless steel, Type 304 or 316, ASTM A666.
  - b. 22 GA steel.
  - c. 1 inches wide, 1 inch deep, nominal 5/8 inches throat with filler.
- F. Veneer Anchorage System for Existing Concrete and Concrete Masonry Back-up:
  1. Adjustable pintle and plate:
    - a. Conform to ASTM A951.
    - b. Cold drawn stainless steel wire pintle, ASTM A82.
    - c. 14 GA stainless steel plate, ASTM A1008.
    - d. Galvanized, ASTM A153/A153M, Class B2.
    - e. 3/16 inches diameter wire x length necessary to embed pintle minimum 2 inches into veneer mortar joint.
- G. Horizontal Joint Reinforcing:
  1. General:
    - a. Conform to ASTM A951.
    - b. Cold drawn steel wire, ASTM A82.
    - c. 9 GA side rods.
    - d. 9 GA cross rods.
    - e. Hot-dipped galvanized, ASTM A153/A153M.
    - f. Prefabricated corner and tee sections with minimum length of 30 inches from point of intersection.
  2. Single wythe wall joint reinforcing: Ladder design.
  3. Composite wall joint reinforcing: Ladder design with double side rod.
  4. Cavity wall joint reinforcing with masonry back-up:
    - a. Ladder design horizontal joint reinforcing.
    - b. Wire eyes welded to horizontal joint reinforcing.
      - 1) Length as necessary to project through rigid insulation into airspace.
    - c. 3/16 inches diameter adjustable pintle veneer anchors.
      - 1) Length as necessary to provide minimum 2 inches embed into veneer mortar joint.
    - d. Hohmann & Barnard "270 Ladder."
- H. Rigid Steel Masonry Anchors:
  1. 1 inches by 1/4 inches with ends turned up 2 inches.
  2. Hot-dipped galvanized steel, ASTM A153/A153M.
  3. Length:
    - a. 24 inches unless noted otherwise.
    - b. Where wall conditions such as jambs or other obstructions preclude the use of 24 inches anchors, shorter anchors may be used.
- I. Mesh Wall Ties:
  1. Hot-dipped galvanized steel, ASTM A153/A153M.
  2. 16 GA, 1/2 inches square mesh.
  3. Width: 2 inches less than nominal wall thickness.
  4. Length: As necessary to embed minimum 6 inches into each wall.
- J. Grout Screen:
  1. Polypropylene monofilament.
  2. 1/4 x 1/4 inches mesh.
  3. Width of grout screen to be 2 inches less than nominal width of CMU.
- K. Weep Joint Mortar Protection System:
  1. 100% recycled polyester.
  2. 90% minimum open weave mesh.
  3. Minimum 10 inches high by full width of air cavity.
  4. Trapezoidal shape.

- L. Preformed Rubber Control Joint Inserts:
  - 1. ASTM D2000, M2AA-805.
  - 2. Hardness: ASTM D2240, Shore A Durometer, 80 +/-5.
  - 3. Ultimate elongation: 350%, ASTM D412.
  - 4. Tensile strength: 1000 psi, ASTM D412.
  - 5. Hohmann & Barnard #RS Series.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Thru Wall Flashing and Stainless Steel Drip:
  - 1. Install to provide positive drainage of cavity moisture.
  - 2. Extend stainless steel drip beyond the exterior face of the wall to minimum distance possible while still allowing drip to perform intended purpose.
  - 3. Extend flashing horizontally beyond each edge of lintel or sills to next vertical mortar joint but not less than 4 IN and turn up edge one full veneer course.
    - a. Seal all joints.
  - 4. Where thru wall flashing steps up or down in the wall, provide end dam at step.
    - a. End dam shall extend up or down to tie into thru wall flashing step.
    - b. Seal all joints for continuous watertight barrier.
  - 5. Lap stainless steel drip minimum of 2 inches and bond two pieces together using stainless steel pop rivets and two beads of lap sealant.
  - 6. At concrete masonry unit back-up, install upper edge of flashing into block joint.
  - 7. At concrete back-up, secure upper edge of flashing into reglet and seal.
  - 8. Adhere vertical surface of flashing to back-up wall with adhesive recommended by flashing manufacturer.
  - 9. Extend flashing minimum of 6 inches above top of weep joint mortar protection system.
  - 10. Lap and seal flashing at all inside and outside corners to provide continuous uninterrupted barrier.
- C. Weeps:
  - 1. Provide open weep joints at maximum 16 inches on-center in head joint of first course of veneer immediately above thru wall flashing.
    - a. Omit mortar bed on top of thru wall flashing at each open weep joint location to allow moisture an unobstructed path to the exterior.
    - b. Weep joints shall be not more than 4 inches high.
  - 2. Provide weep vents maximum 16 inches OC in top course of veneer or as indicated on Drawings.
    - a. Do not use weep vents in weep joints at the bottom of the wall.
    - b. Set weep vents back away from face of veneer slightly so the front edge of the vent is contained within the mortar joint.
- D. Weep Joint Mortar Protection System:
  - 1. Install continuous row(s) of material.
  - 2. Provide multiple thicknesses of material compressed as necessary to completely fill the entire air cavity.
    - a. Thickness to be at least 10% wider than air cavity being filled.
  - 3. Set material directly on top of thru wall flashing.
- E. Butt joints of preformed control joint inserts tightly together and secure with adhesive or sealant acceptable to insert manufacturer.
- F. Anchoring Veneer:
  - 1. Veneer with concrete block back-up:

- a. Anchor veneer to new construction using horizontal joint reinforcing and adjustable pintle veneer anchors.
  - 2. Veneer with concrete back-up:
    - a. Anchor veneer to new construction using dovetail anchors and slots.
    - b. Anchor veneer to existing construction using adjustable pintle and plate.
    - c. Provide veneer anchorage at not more than 16 inches on-center vertically and 16 inches on-center horizontally.
- G. Reinforcing Masonry:
- 1. General:
    - a. Provide continuous horizontal joint reinforcing in all concrete masonry wall construction.
      - 1) Embed longitudinal side rods in mortar for entire length with minimum cover of 5/8 inches on exterior side of walls and 1/2 inches at other locations.
        - a) For interior partitions, the "exterior" side of the wall is considered the side having the most corrosive atmosphere or the corridor side of the wall.
      - 2) Lap reinforcement minimum of 12 inches at ends.
        - a) Remove cross wires on one side of the lap splice and bend the side rods slightly so the lap is provided with 12 inches of uninterrupted wire lap occurring in the same plane.
      - 3) Do not bridge control joints with horizontal joint reinforcing.
      - 4) Do not bridge expansion joints with horizontal joint reinforcing.
      - 5) At corners and wall intersections use prefabricated "L" and "T" horizontal joint reinforcing sections.
      - 6) Cut and bend as necessary.
    - b. Install reinforcing at 16 inches on-center vertically unless noted otherwise on Drawings.
    - c. Install reinforcing 8 inches on-center vertically for a minimum of 24 inches at starter courses.
      - 1) Do not install horizontal joint reinforcing in veneer mortar joint having through-wall flashing.
    - d. In concrete masonry back-up construction, install horizontal joint reinforcing and adjustable pintle veneer anchors at 8 inches on-center in parapets.
      - 1) Parapets begin at the course immediately above the top of the roof structural member or top of concrete topping slab on precast roof structure.
    - e. In concrete masonry back-up construction, install additional horizontal joint reinforcing and adjustable pintle veneer anchors 16 inches on-center in courses on each side of vertical control joints and on each jamb of openings for full height of joint or opening.
      - 1) Alternate with normal wall horizontal joint reinforcing.
      - 2) Extend reinforcing minimum 32 inches beyond joint or jambs of opening.
    - f. In concrete masonry back-up construction, reinforce masonry openings over 12 inches wide with horizontal joint reinforcing and adjustable pintle veneer anchors placed in three horizontal joints above lintel and two horizontal joints below sill.
      - 1) Extend minimum of 32 inches beyond jambs of opening.
  - 2. Reinforcing concrete masonry:
    - a. Install reinforcing bars where indicated on Drawings.
      - 1) Provide means necessary to ensure position of vertical steel reinforcing meets requirements of the building code.
    - b. At intersecting load-bearing walls, provide rigid steel anchors 16 inches on-center vertically, embed ends in grout filled cores.
      - 1) Alternate rigid steel anchors with horizontal joint reinforcing.
    - c. At intersecting non-load bearing walls or at intersecting load bearing/non-load bearing walls provide mesh wall ties in mortar joint at 16 inches on-center vertically.
      - 1) Extend minimum 6 inches into each wall.
      - 2) Alternate mesh wall ties with horizontal joint reinforcing.

- d. Anchor intersecting concrete masonry to intersecting cast-in-place or precast concrete using dovetail slots and anchors.
    - 1) Provide dovetail anchors at 16 inches OC or as noted on Drawings.
- 3. Repair all galvanized coatings damaged as a result of welding.
  - a. See Specification Section 05 50 00 for galvanizing repair system.
- 4. Reinforcing veneer:
  - a. Reinforce veneer with joint reinforcement placed in veneer mortar joints:
    - 1) In new masonry back-up construction alternate veneer horizontal joint reinforcing with horizontal joint reinforcing and adjustable pintle veneer anchors.
    - 2) In new concrete back-up construction alternate veneer horizontal joint reinforcing with dovetail anchors.
- H. Install reglets as walls are being constructed.
  - 1. Set reglets true with wall, plumb and at consistent depth.
- I. Remove all excess mortar and grout from reglets as walls are being constructed and protect reglet openings from filling with mortar, grout and other construction debris.

### **END OF SECTION**

**SECTION 04 05 50**  
**COLD AND HOT WEATHER MASONRY CONSTRUCTION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Cold weather protection.
  - 2. Hot weather protection.
- B. Related Specification Sections include but are not necessarily limited to:

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Brick Industry Association (BIA):
    - a. Technical Note 1, Cold and Hot Weather Construction.
  - 2. National Concrete Masonry Association (NCMA).
    - a. TEK 3-1C, All Weather Concrete Masonry Construction.
  - 3. The Masonry Society (TMS):
    - a. 602, Specification for Masonry Structures.

**1.3 DEFINITIONS**

- A. As defined in TMS 602.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION**

**3.1 ERECTION AND APPLICATION**

- A. General:
  - 1. Comply with NCMA TEK 3-1C and BIA Tech Note 1 recommendations and practices.
  - 2. Do not use frozen or ice coated materials.
  - 3. At end of each day or at shutdown, cover tops of all walls not enclosed or sheltered with clear polyethylene minimum 6 mil thick.
    - a. Extend down each side of wall minimum of 16 inches and secure.
- B. Temporary Facilities:
  - 1. Construct and maintain temporary protection required to permit continuous and orderly progress of work.
  - 2. Provide and maintain heat sufficient to assure temperature above 32 degrees F within protected areas.
  - 3. Remove all temporary facilities after completion of work.
- C. Cold Weather Construction and Protection Requirements:
  - 1. Prior to and during installation:
    - a. Air temperature 32 to 40 degrees F: Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 degrees F.
    - b. Air temperature 25 to 32 degrees F:
      - 1) Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 degrees F.
      - 2) Maintain mortar temperatures above freezing until used.
    - c. Air temperature below 25 degrees F:

- 1) Heat mixing water and aggregate to produce mortar temperatures between 40 and 120 degrees F.
  - 2) Maintain mortar temperatures above freezing until used.
  - 3) Maintain temperature of units until laid at not less than 40 degrees F.
  - 4) Provide heat on both sides of walls under construction to maintain air temperature above freezing.
  - 5) Provide windbreaks or shelters when wind is in excess of 15 mph.
    - a) Wind breaks or shelters shall be translucent.
2. After installation:
- a. Air temperature 32 to 40 degrees F: Protect from rain or snow for not less than 24 hours by covering with weather-resistive translucent membrane.
  - b. Air temperature 25 to 32 degrees F: Completely cover with translucent weather-resistive membrane for not less than 24 hours.
  - c. Air temperature 20 to 25 degrees F: Completely protect with insulating blankets for not less than 24 hours or provide other protection approved by Engineer.
  - d. Air temperature below 20 degrees F:
    - 1) Provide enclosed translucent shelters and heating to maintain air temperature on each side of wall above 32 degrees F for 24 hours.
    - 2) Do not allow rapid drop in temperature after removal of heat.
  - e. Promptly repair all tears, holes, etc., to translucent membrane and shelter using compatible patching material and tape as recommended by membrane manufacturer.
- D. Hot Weather Construction and Protection Requirements:
1. Comply with requirements of NCMA, BIA and TMS 602.
  2. Storage and preparation of materials.
    - a. Cover or shade masonry units and mortar materials from direct sun.
    - b. Maintain sand in a damp loose condition.
      - 1) Sand moisture shall be maintained at minimum 8%.
      - 2) Sprinkle with cool water as required to maintain moisture content.
    - c. Use cool water for mixing mortars.
    - d. Avoid using tools and equipment that have been sitting in the sun.
      - 1) Sprinkle mortar boards, mortar pans, wheel barrows, mixers, etc., with cool water.
    - e. Do not wet concrete masonry units prior to use.
  3. Installation:
    - a. Place masonry units within one minute of the spreading of the mortar.
      - 1) Mortar beds shall not be spread more than 4 feet ahead of the masonry unit being placed.
    - b. Provide wind screens and shading partitions as required to eliminate direct sunlight exposure.
    - c. Wet installed units using fog spray of clean water.
    - d. Cover installed work immediately after installation to slow rate of loss of moisture from units.
    - e. Fog-spray new masonry work until damp.
      - 1) Repeat fog spraying minimum of three times per day until masonry work has cured for 72 hours.
      - 2) In high humidity conditions, Engineer reserves the right to discontinue fog spraying if operation is found to be introducing excessive amounts of moisture into the Work.

## END OF SECTION

		Standardized abbreviations of all Specifications.
		2022 System-Wide Specification Updates.
		Replaced "MSJC Specification" with "TMS 602" (one that was missed on the below)





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## **SECTION 04 22 00**

### **CONCRETE MASONRY**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Concrete masonry construction (CMU), including:
    - a. Standard concrete masonry.
    - b. Pre-colored masonry.
    - c. Split-face masonry.
    - d. Precast concrete lintels.
  - 2. Integral water repellent admixture.
  - 3. Masonry special inspection.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 21 00 - Reinforcement.
  - 2. Section 03 31 30 - Concrete, Materials and Proportioning.
  - 3. Section 04 05 13 - Masonry Mortar and Grout.
  - 4. Section 04 05 23 - Masonry Accessories.
  - 5. Section 04 05 50 - Cold and Hot Weather Masonry Construction.
  - 6. Section 07 21 00 - Building Insulation.
  - 7. Section 07 92 00 - Joint Sealants.

##### **1.2 REFERENCES**

- A. Terminology:
  - 1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the meaning indicated below:
    - a. Terminology used in this Section are in accordance with “Standard Unit Nomenclature” Table 1, NCMA TEK 2-3A.
- B. Reference Standards:
  - 1. ASTM International (ASTM):
    - a. C33, Standard Specification for Concrete Aggregates.
    - b. C55, Standard Specification for Concrete Building Brick.
    - c. C90, Standard Specification for Loadbearing Concrete Masonry Units.
    - d. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
    - e. C426, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.
    - f. C1357, Standard Test Methods for Evaluating Masonry Bond Strength.
    - g. E514, Standard Test Method for Water Penetration and Leakage Through Masonry.
  - 2. National Concrete Masonry Association (NCMA):
    - a. TEK 2-3A, Architectural Concrete Masonry Units.
    - b. TEK 3-4B, Bracing Concrete Masonry Walls During Construction.
    - c. TEK 8-2A, Removal of Stains from Concrete Masonry.
    - d. TEK 8-3A, Control and Removal of Efflorescence.
  - 3. The Masonry Society (TMS):
    - a. 602, Specification for Masonry Structures.

##### **1.3 QUALITY ASSURANCE:**

- A. Qualifications:
  - 1. Concrete masonry unit manufacturer shall be licensed or qualified, in writing, by manufacturer of integral water repellent admixture to produce masonry units containing manufacturer's admixture.

- a. Concrete masonry unit manufacturer shall have not less than five years experience manufacturing masonry units containing admixture manufacturer's products.
- B. Mockups:
  - 1. Mockups – General: Prior to permanent wall construction, construct mockup.
    - a. Construct mockup on a concrete slab as necessary to demonstrate construction details.
      - 1) Minimum slab thickness: four inches.
    - b. Mockup shall show full color range, texture and bond pattern(s) of each type masonry required.
    - c. Size: As large as necessary to properly display all conditions required by masonry construction.
      - 1) Not less than four feet high by eight feet long.
        - a) Return corners and intersections not less than four feet.
      - 2) Mockup shall demonstrate:
        - a) Outside corner condition.
        - b) Inside corner condition.
        - c) Intersection of interior masonry partition.
        - d) Jamb condition demonstrating lintel bearing and flashing.
        - e) Masonry control joint.
    - d. Include all special corners and other special CMU detailing shown on the Drawings.
    - e. Include all types of masonry shown on the Drawings, including:
      - 1) Pre-colored masonry.
      - 2) Split-face masonry.
      - 3) Precast lintel.
      - 4) Cast stone.
      - 5) Brick masonry.
    - f. Mockup shall include:
      - 1) Each type of masonry required for the Work.
        - a) Each type of special shape.
        - b) Each type of back-up wall system(s).
      - 2) Vertical wall reinforcing with grouted cell.
      - 3) Typical bond beam construction.
      - 4) Typical lintel construction.
      - 5) Positioning, securing and lapping of reinforcing steel.
      - 6) Masonry accessories:
        - a) Horizontal joint reinforcing.
          - (1) Positioning and lapping of joint reinforcing.
        - b) Veneer anchorage system(s).
        - c) Thru wall flashing and drip edge.
          - (1) Demonstrate inside and outside corner conditions showing thru wall flashing lapping, jointing and sealing.
        - d) Weep joint mortar protection system.
        - e) Weep joints and weep vents.
        - f) Typical control joint construction.
        - g) Mesh wall ties.
        - h) Rigid steel masonry anchors.
      - 7) Insulation.
      - 8) Cleaning of masonry work.
  - 2. Step construction of mockup to allow observation of components.
  - 3. Following acceptance of mockup by Engineer, shall constitute minimum standard of quality for the Work.
    - a. Maintain and safeguard mockup until Substantial Completion.
  - 4. If not acceptable as determined by Engineer, provide additional mockups as necessary.
  - 5. Remove mockups when directed by Engineer.

## **1.4 SUBMITTALS**

- A. Action Submittals: Submit the following:
1. Shop Drawings:
    - a. Scaled (minimum 1/8 inches per foot) plans showing proposed locations of masonry control joints.
    - b. Wall elevations and sections, indicating special shapes, shape part numbers, applicable dimensions.
    - c. Detail drawings for:
      - 1) Precast concrete lintels.
        - a) Show profiles, cross-sections, reinforcement and steel components.
  2. Product Data:
    - a. Manufacturer's information on aggregate and cement type used in manufacture.
    - b. Data sheet on each type of masonry unit required, including:
      - 1) Pre-colored masonry.
      - 2) Split-face masonry.
    - c. Data sheets on integral water repellent admixture being used in masonry unit manufacturing.
    - d. Technical bulletins on cleaning masonry containing integral water repellent.
  3. Samples:
    - a. Concrete Masonry Finish Samples: Manufacturer's complete offering of colors and textures for each type of masonry required.
      - 1) Not less than three inches by three inches Samples for initial selection by Engineer, in consultation with Owner.
      - 2) Submit two, Samples, each eight inches by eight inches, of each type of masonry selected, for final approval by Engineer, in consultation with Owner.
      - 3) Samples of standard gray-colored masonry are not required.
- B. Informational Submittals: Submit the following:
1. Certifications:
    - a. Certification that concrete masonry units meet or exceed requirements of standards referenced.
    - b. Certification that fire-resistive rated units meet the requirements of applicable building code.
    - c. Certification that integral water repellent admixture will not affect the use of coloring processes or alter actual colors of factory colored masonry units.
    - d. Certification of integral water repellent admixture dosage rates from concrete masonry unit Supplier.
    - e. Concrete masonry Supplier shall certify that integral liquid water repellent admixture was furnished at dosage rate recommended by admixture manufacturer for use in exterior (outdoor) wall construction.
  2. Supplier Instructions:
    - a. Instructions for handling, storing, and installation.
  3. Source Quality Control Submittals:
    - a. Results of tests, inspections, and other quality control activities required by the Contract Documents and performed at the place of production or fabrication.
  4. Field Quality Control Submittals:
    - a. Results of tests, inspections, and other quality control activities required by the Contract Documents and performed at the Site.
  5. Qualifications:
    - a. Supplier of masonry units when requested by Engineer.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Acceptance Requirements:
1. Inspect units upon delivery, to verify color match with mockup or approved samples, dimensional quality, and trueness of unit.

- B. Storage and Handling Requirements:
  - 1. Covering material shall be weather-proof but vapor permeable to prevent accumulation of moisture under cover.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Standard masonry units:
    - a. Any manufacturer capable of meeting the requirements of this Specification Section.
  - 2. Integral water repellent admixture:
    - a. GCP Applied Technologies, Inc.
    - b. ACM Chemistries, Inc.

### **2.2 MATERIALS**

- A. Cement: Type I or II Portland, ASTM C150.
- B. Aggregate: ASTM C33.
- C. Reinforcing Bars: Refer to Section 03 21 00.
- D. Mortar: Refer to Section 04 05 13.
- E. Masonry Grout: Refer to Section 04 05 13.
- F. Masonry Accessories: Refer to Section 04 05 23.
- G. Insulation: Refer to Section 07 21 00.
- H. Sealants: Refer to Section 07 92 00.
- I. Integral Concrete Masonry Water Repellent:
  - 1. Liquid polymeric admixture.
  - 2. GCP Applied Technologies, Inc., "DRY-BLOCK".

### **2.3 MANUFACTURED UNITS**

- A. General:
  - 1. Masonry units of each type, color, or face style shall be from a single production run by Supplier.
  - 2. Factory fabricate special shapes unless otherwise required.
  - 3. Fire resistive units: Fabricate to comply with applicable building code.
  - 4. Fabricated in manufacturing facility.
  - 5. Provide square corners unless required otherwise.
- B. Concrete Masonry Units:
  - 1. Modular units: ASTM C90.
    - a. Normal weight units: Minimum of 125 pound/cubic foot.
    - b. Light weight or medium weight units are not acceptable.
  - 2. Concrete bricks:
    - a. Structural units: ASTM C55.
      - 1) Same material, texture and density as modular units.
  - 3. Color:
    - a. Interior units: Standard gray.
    - b. Exposed exterior units: Precolored.
  - 4. Design compressive strength:  $f_m=1,500$  PSI minimum.
    - a. Determine in accordance with TMS 602.
      - 1) Unit strength method, sampled and tested in accordance with ASTM C140.

5. Provide masonry units manufactured with integral water repellent admixture for the following exposures:
  - a. Exterior veneer.
  - b. Exterior single-wythe construction.
  - c. Exterior composite wall construction.
  - d. Interior areas defined as wet and/or corrosive.
    - 1) See Specification Section 07 92 00 for definition of wet and/or corrosive areas.
6. Special shapes and faces:
  - a. Corner units.
    - 1) Corner units used in veneer wythe shall have a finished return leg one-half the length of a standard modular stretcher unit.
    - 2) Corner units shall maintain regular modular masonry coursing.
  - b. Finished end units.
  - c. Other special shapes as indicated on Drawings or necessary to maintain coursing.
- C. Precast concrete lintels:
  1. Concrete: See Specification Section 03 21 00.
  2. Reinforcing: See Specification Section 03 21 00.
  3. Embedded steel components: Galvanized.
    - a. See Specification Section 05 50 00.

## **2.4 PERFORMANCE AND DESIGN REQUIREMENTS:**

- A. Integral Concrete Masonry Water Repellent:
  1. Water permeance of masonry: Capable of achieving a Class E Rating when evaluated using ASTM E514 with the test extended to 72 hours, using the rating criteria specified in ASTM E514.
  2. Flexural bond strength of masonry: An increase of 10%, minimum, in masonry flexural bond strength shall occur as a result of adding integral water-repellent concrete masonry and mortar admixtures when compared to a control (containing no admixtures) concrete masonry and mortar tested in accordance with ASTM C1357.
  3. Compressive strength validation shall be per unit strength method.
  4. Drying shrinkage of masonry: Maximum 5% increase in drying shrinkage of the concrete masonry units shall occur as a result of adding integral water repellent concrete masonry admixture when compared to a control (containing no admixtures) concrete masonry when tested in accordance with ASTM C426.
  5. Grout shear bond strength: Maximum 5% decrease in grout shear bond strength shall occur as a result of adding integral water repellent admixture to the concrete masonry units when compared to a control (containing no admixtures).

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Verify that anchors and flashings are correct.
- B. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints.
  1. Properly locate openings, movement type joints, returns, offsets, weep joints and weep vents.

### **3.2 INSTALLATION**

- A. General:
  1. Build in flashing, reinforcing, reglets, weeps, weep vents and related accessory items.
    - a. See Specification Section 04 05 23 for installation of accessory items.
  2. Perform all cutting using masonry saw blades.
  3. Drill holes using masonry drill bits or core drill.
    - a. Holes made by chipping unit will not be accepted.

4. Install field units in running bond, unless noted otherwise.
    - a. Provide special coursing where indicated on the Drawings.
  5. Cut as required to maintain bond pattern.
  6. Use solid units where cutting or laying would expose holes and as noted on Drawings.
  7. Avoid use of less than half size units, whenever possible.
  8. Do not use chipped, cracked, spalled, stained or imperfect units exposed in finish work.
  9. Provide units of uniform color, within the range demonstrated on the approved mock-up.
  10. Do not wet concrete masonry units.
  11. Build chases and recesses as indicated and required for work of other trades.
    - a. Provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses unless detailed otherwise on the Drawings.
  12. In fire-resistive rated wall construction, install fire resistive units in accordance with the building code.
- B. Concrete Masonry Units:
1. Grout solid all cells containing steel reinforcing and as indicated on Drawings.
    - a. Refer to Specification Section 04 05 13 for grouting.
- C. Laying and Tooling:
1. Lay masonry units with completely filled bed and head joints.
    - a. Provide full mortar bed on all block cross webs and completely fill head joints.
      - 1) Do not slush head joints.
      - 2) Protect cells requiring grout fill from mortar droppings.
      - 3) Omit mortar from head joint at weep joint opening.
  2. Maintain nominal 3/8 inches joint widths.
    - a. Cut joints flush where concealed and where veneer plaster coating is required.
    - b. Tool exposed joints concave.
    - c. Compress mortar in below ground joints and in joints concealed by insulation in cavity wall construction.
    - d. Provide wider joints where noted on Drawings.
      - 1) In no case shall any mortar joint be more than 3/4 inches wide.
    - e. Where masonry sits on top of steel support omit the mortar joint on top of the support and sit masonry directly on top of the thru wall flashing or the steel support member unless a mortar joint is required to maintain coursing.
  3. During tooling of joints, enlarge any voids or holes except weeps, and completely fill with mortar.
  4. Point-up all joints at corners, openings, and adjacent work to provide neat, uniform appearance.
  5. Remove masonry disturbed after laying.
    - a. Clean and relay in fresh mortar.
    - b. Do not pound units to fit.
    - c. If adjustments are required, remove units, clean, and reset in fresh mortar.
  6. Where work is stopped and later resumed, rack back 1/2 masonry unit length in each course.
    - a. Remove loose units and mortar prior to laying fresh masonry.
  7. As work progresses, build in items indicated on Drawings and specified.
    - a. Fill in solidly with mortar around built-in items.
    - b. Where built-in items are to be embedded in cores of hollow masonry units, place grout screen in joint below and fill core solid with mortar.
- D. Control Joints and Sealants:
1. Provide vertical expansion, control and isolation joints where indicated on Drawings.
  2. Where not indicated on Drawings, submit proposed control joint locations in accordance with the following requirements:
    - a. Provide control joints at maximum 24 feet OC.
    - b. Provide at all T intersections.



- c. Locate joints so as to allow lintels and bond beams above and below openings to extend beyond the opening as indicated on the Drawings without control joints thru the lintel or bond beam.
- 3. Rake out mortar in joint.
- 4. Refer to Specification Section 07 92 00 for sealant installation requirements.
  - a. Seal control and expansion joints.
- E. Tolerances:
  - 1. Maximum variation from plumb in vertical lines and surfaces of columns, walls, and arises:
    - a. 1/4 inches in 10 feet.
    - b. 3/8 inches in a story height not to exceed 20 feet.
    - c. 1/2 inches in 40 feet or more.
  - 2. Maximum variation from plumb for external corners, expansion joints, and other conspicuous lines:
    - a. 1/4 inches in any story or 20 feet maximum.
    - b. 1/2 inches in 40 feet or more.
  - 3. Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
    - a. 1/4 inches in any bay or 20 feet.
    - b. 1/2 inches in 40 feet or more.
  - 4. Maximum variation from plan location of related portions of columns, walls, and partitions:
    - a. 1/2 inches in any bay or 20 feet.
    - b. 3/4 inches in 40 feet or more.
  - 5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on Drawings:
    - a. Minus 1/4 inches.
    - b. Plus 1/2 inches.
  - 6. Maximum variation in mortar joint width:
    - a. Bed joints: 3/32 inches in 10 feet.
    - b. Head joints:
      - 1) Minus 1/8 inches.
      - 2) Plus 1/8 inches.
- F. Protect against weather when work is not in progress.
  - 1. During inclement weather conditions, cover top of walls with translucent waterproof membrane.
  - 2. See Specification Section 04 05 50.
- G. Protect against cold/hot weather as specified in Specification Section 04 05 50.

### **3.3 FIELD QUALITY CONTROL**

- A. Bracing Concrete Masonry Walls During Construction:
  - 1. At a minimum, provide bracing in accordance with NCMA TEK 3-4B.
  - 2. Contractor is responsible for adequately bracing all masonry during construction.
- B. Remove and replace loose, stained, damaged and other unacceptable units as directed by Engineer.
  - 1. Provide new units to match.
  - 2. Install in fresh mortar.
  - 3. Point to eliminate evidence of replacement.
- C. Special Masonry Inspection:
  - 1. Masonry inspection services will be provided during the following construction activities:
    - a. Cost of masonry inspection services will be paid by Owner.
    - b. During laying of units:
      - 1) During the first day of the masonry construction, inspect proportions of site prepared mortar, construction of mortar joints, location of all reinforcing and

- connectors, size and location of structural elements, type, size and location of anchors, protection of masonry during cold weather.
- 2) Inspection to be continuous the first full day of masonry construction which requires special inspection.
    - a) Thereafter, a minimum of 3 hours every third day of construction until the concrete masonry work is complete.
  - 3) Inspection while laying masonry units may be made concurrently with other inspection duties provided all inspection duties are adequately performed.
  - 4) When deficiencies are found, additional inspection shall be provided as required until deficiencies have been corrected.
  - 5) If masonry crews change, an additional full day of inspection is required during the first day the new crew is on-site.
- c. Placement of reinforcing steel:
- 1) Verification of all reinforcing including size, grade, lap lengths, and type.
  - 2) Inspection may be periodic as required to verify all reinforcing.
  - 3) Inspector to be present during the concrete pour in which any dowels connecting concrete to masonry are cast.
    - a) Inspector to verify proper location of dowels.
- d. Prior to each grouting operation, verify that grout space is clean, reinforcing is clean and connectors are properly placed, proportions of site-prepared grout are correct and mortar joints have been properly constructed.
- 1) Inspection may be periodic as required to verify proper grout space.
- e. Verify compliance with building code and Specifications continuously during all grouting operations.
- f. Provide special inspection in accordance with the building code Table 1704.5.1 including observation of masonry work for conformance to the Contract Documents:
- 1) Provide inspection reports to the Engineer, Building Official and Owner.
    - a) Notify Contractor of discrepancies for correction.
    - b) Notify Engineer, Building Official and Owner, in writing, when discrepancies have been satisfactorily corrected.
  - 2) Submit final signed report stating that work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the Contract Documents and the applicable workmanship provisions of the building code.

### **3.4 CLEANING**

- A. Clean concrete masonry as the wall is being constructed using fiber brushes, wooden paddles and scrapers.
1. Do not use metal tools or wire brushes.
  2. No acid-based cleaning solutions shall be used unless approved in writing by Engineer.
- B. Remove dirt and stains in accordance NCMA TEK 8-2A.
- C. Remove primary efflorescence in accordance with NCMA TEK 8-3A.

### **END OF SECTION**



DIVISION 05

METALS



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## **SECTION 05 50 00**

### **METAL FABRICATIONS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be supplied under work of other Specification Sections.
  - 2. Design of all temporary bracing not indicated on Drawings.
  - 3. Design of systems and components, including but not limited to:
    - a. Stairs.
    - b. Landings.
    - c. Ladders.
    - d. Modular framing system.
    - e. Grating
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 31 30 – Concrete materials and proportions.
  - 2. Section 03 15 19 - Anchorage to Concrete.
  - 3. Section 03 31 30 - Concrete, Materials and Proportioning.
  - 4. Section 06 82 00 - Fiberglass Reinforced Plastic Fabrication.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Aluminum Association (AA):
    - a. ADM 1, Aluminum Design Manual.
  - 2. American Association of State Highway and Transportation Officials (AASHTO):
    - a. HB, Standard Specifications for Highway Bridges.
  - 3. American Institute of Steel Construction (AISC):
    - a. 325, Manual of Steel Construction.
    - b. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
  - 4. The American Ladder Institute (ALI):
    - a. A14.3, Ladders - Fixed - Safety Requirements.
  - 5. American Society of Civil Engineers (ASCE):
    - a. 7, Minimum Design Loads for Buildings and Other Structures.
  - 6. ASTM International (ASTM):
    - a. A6, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
    - b. A36, Standard Specification for Carbon Structural Steel.
    - c. A47, Standard Specification for Ferritic Malleable Iron Castings.
    - d. A48, Standard Specification for Gray Iron Castings.
    - e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - f. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
    - g. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - i. A197, Standard Specification for Cupola Malleable Iron.
    - j. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

- k. A276, Standard Specification for Stainless Steel Bars and Shapes.
- l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- m. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- n. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
- o. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- p. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- q. A536, Standard Specification for Ductile Iron Castings.
- r. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
- s. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- t. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- u. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- v. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
- w. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- x. A786, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
- y. A992, Standard Specification for Steel for Structural Shapes.
- z. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- aa. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- bb. B26, Standard Specification for Aluminum-Alloy Sand Castings.
- cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- dd. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- ee. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- ff. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
- gg. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
- hh. F436, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
- ii. F467, Standard Specification for Nonferrous Nuts for General Use.
- jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
- kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- ll. F835, Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
- mm. F879, Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
- nn. F1789, Standard Terminology for F16 Mechanical Fasteners.
- oo. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
- 7. American Welding Society (AWS):
  - a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
  - b. D1.1, Structural Welding Code - Steel.

- c. D1.2, Structural Welding Code - Aluminum.
  - d. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
- 8. National Association of Architectural Metal Manufacturers (NAAMM):
  - a. AMP 510, Metal Stairs Manual.
  - b. AMP 555, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).
  - c. MBG 531, Metal Bar Grating Manual.
- 9. NACE International (NACE).
- 10. Nickel Development Institute (NiDI):
  - a. Publication 11 007, Guidelines for the welded fabrication of nickel-containing stainless steels for corrosion resistant services.
- 11. Occupational Safety and Health Administration (OSHA):
  - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
- B. Qualifications:
  - 1. Qualify welding procedures and welding operators in accordance with AWS.
  - 2. Fabricator shall have minimum of 10 years of experience in fabrication of metal items specified.
  - 3. Engineer for contractor-designed systems and components: Professional structural engineer licensed in the State of ME.
  - 4. NACE certified inspector shall have minimum of two years of experience performing inspections as indicated.
    - a. Have a current Level III coating inspector certification.

### 1.3 DEFINITIONS

- A. Fasteners: As defined in ASTM F1789.
- B. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 oz of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.
- C. Hardware: As defined in ASTM A153/A153M.
- D. Installer or Applicator:
  - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  - 2. Installer and applicator are synonymous.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  - 1. Qualifications:
    - a. NACE inspector qualifications.
  - 2. Fabrication and/or layout drawings and details:
    - a. Submit drawings for all fabrications and assemblies.
      - 1) Include erection drawings, plans, sections, details and connection details.
    - b. Identify materials of construction, shop coatings and third party accessories.
  - 3. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Provide manufacturer's standard allowable load tables for the following:
      - 1) Grating and checkered plate.
      - 2) Castings, trench covers and accessories.
  - 4. Modular framing systems. Contractor designed systems and components:
    - a. Certification that manufactured units meet all design loads specified.
    - b. Shop Drawings and engineering design calculations:
      - 1) Indicate design live loads.

- 2) Sealed by a licensed professional engineer, registered in the State of ME.
    - 3) Engineer will review for general compliance with Contract Documents.
  - c. Contractor designed systems and components include the following:
- B. Informational Submittals:
  - 1. Certification of welders and welding processes.
    - a. Indicate compliance with AWS.
  - 2. NACE certification of surface preparation.
  - 3. NACE certification of paint application.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and handle fabrications to avoid damage.
- B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Abrasive stair nosings (embedded in concrete stairs):
    - a. American Safety Tread.
    - b. Balco.
  - 2. Headed studs and deformed bar anchors:
    - a. Nelson Stud Welding Div., TRW Inc.
    - b. Stud Welding Products, Inc.
  - 3. Mechanical anchor bolts:
    - a. See Section 03 15 19.
  - 4. Epoxy adhesive anchor bolts:
    - a. See Section 03 15 19.
  - 5. Concrete screw anchors:
    - a. See Section 03 15 19.
  - 6. Castings, trench covers and accessories:
    - a. Neenah Foundry Co.
    - b. Deeter Foundry Co.
    - c. Barry Craft Construction Casting Co.
    - d. McKinley Iron Works.
  - 7. Aluminum ladders:
    - a. Any manufacturer capable of meeting the requirements of this Specification Section.
  - 8. Galvanizing repair paint:
    - a. Clearco Products Co., Inc.
    - b. ZRC Products.
  - 9. Modular framing system:
    - a. Unistrut Building Systems.
    - b. B-Line Systems.
    - c. Kindorf.
    - d. Superstrut.
  - 10. Ladder safety extension post:
    - a. Bilco.

### **2.2 MATERIALS**

- A. Steel:
  - 1. Structural:
    - a. W-shapes and WT-shapes: ASTM A992, Grade 50.



- b. All other plates and rolled sections: ASTM A36.
  - 2. Pipe: ASTM A53, Types E or S, Grade B or ASTM A501.
  - 3. Structural tubing:
    - a. ASTM A500, Grade B (46 ksi minimum yield).
  - 4. Bolts, high strength:
    - a. ASTM F3125, Grade A325.
  - 5. Nuts, high strength:
    - a. ASTM A563.
  - 6. Washers (hardened):
    - a. ASTM F436.
    - b. Provide two (2) washers with all bolts.
  - 7. Bolts and nuts (unfinished):
    - a. ASTM A307, Grade A.
  - 8. Welding electrodes: AWS D1.1, E70 Series.
  - 9. Steel forgings: ASTM A668.
- B. Iron:
- 1. Ductile iron: ASTM A536.
  - 2. Gray cast iron: ASTM A48 (minimum 30,000 psi tensile strength).
  - 3. Malleable iron: ASTM A47, ASTM A197.
- C. Stainless Steel:
- 1. Stainless steel in welded applications: Low carbon 'L' type.
  - 2. Minimum yield strength of 30,000 psi and minimum tensile strength of 75,000 psi.
    - a. Bars, shapes: ASTM A276, Type 304.
    - b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 304 or 316.
    - c. Strip, plate and flat bars: ASTM A666, Type 304 or 316.
    - d. Bolts and nuts: ASTM F593, Type 304 or 316.
  - 3. Minimum yield strength of 25,000 psi and minimum tensile strength of 70,000 psi.
    - a. Strip, plate and flat bar for welded connections, ASTM A666, Type 304L or 316L.
  - 4. Welding electrodes: In accordance with AWS for metal alloy being welded.
- D. Aluminum:
- 1. Alloy 6061-T6, 32,000 psi tensile yield strength minimum.
    - a. ASTM B221 and ASTM B308 for shapes including beams, channels, angles, tees and zees.
    - b. Weir plates, baffles and deflector plates, ASTM B209.
  - 2. Alloy 6063-T5 or T6, 15,000 psi tensile yield strength minimum.
    - a. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
  - 3. ASTM B26 for castings.
  - 4. ASTM F468, alloy 2024 T4 for bolts.
  - 5. ASTM F467, alloy 2024 T4 for nuts.
  - 6. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.
- E. Washers: Same material and alloy as found in accompanying bolts and nuts.
- F. Embedded Anchor Bolts:
- 1. See Specification Section 03 15 19.
- G. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
- 1. See Specification Section 03 15 19.
- H. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.
- I. Deformed Bar Anchors: ASTM A1064 with a minimum yield strength of 70,000 psi and a minimum tensile strength of 80,000 psi.

- J. Iron and Steel Hardware: Galvanized in accordance with ASTM A153/A153M when required to be galvanized.
- K. Galvanizing Repair Paint:
  - 1. High zinc dust content paint for regalvanizing welds and abrasions.
  - 2. ASTM A780.
  - 3. Zinc content: Minimum 92% in dry film.
  - 4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."
- L.

## 2.3 MANUFACTURED UNITS

- A. Ladders:
  - 1. General:
    - a. Fully welded type.
      - 1) All welds to be full penetration welds, unless otherwise specified.
    - b. All ladders of a particular material shall have consistent construction and material shapes and sizes unless noted otherwise on the Drawings.
    - c. Design ladder in accordance with OSHA Standards, ANSI A14.3, ASCE 7 and the building code.
    - d. Ladders shall be designed to support a minimum concentrated live load of 300 pounds at any point to produce the maximum stress in the member being designed.
      - 1) Apply additional 300 pound loads for each section of ladder exceeding 10 feet.
    - e. Maximum allowable stresses per AA ADM 1.
    - f. Maximum lateral deflection: Side rail span/240 when lateral load of 100 pounds is applied at any location.
  - 2. Material:
    - a. Aluminum.
    - b. Finish:
      - 1) Mill.
  - 3. Rails:
    - a. Round pipe or rectangular tubing:
      - 1) Round pipe:
        - a) 1-1/2 inches nominal diameter.
        - b) Schedule 80.
      - 2) Rectangular tubing:
        - a) Cross-section: 3 by 2 inches maximum.
        - b) Thickness: 0.125 inches minimum.
    - b. Spacing:
      - 1) Minimum clear distance between rails to be 18 inches.
      - 2) Step-through ladder extensions: 24 inches, clear minimum, 30 inches maximum.
      - 3) Ladders equipped with ladder safety system: 36 inches clear.
    - c. Provide cap at exposed top and bottom of side rails.
      - 1) Provide weep holes as necessary to prevent the accumulation of moisture within hollow members.
    - d. Extend side rails of step-through ladders a minimum of 42 inches above the landing.
  - 4. Rungs:
    - a. Minimum 1 inch diameter or 1 inch square solid bar.
      - 1) Integral non-slip finish on all sides.
        - a) Non-slip finish: Coarse knurling or extruded serrations.
        - b) Shop or field-applied grit tape and cap type non-slip finishes are not acceptable.
    - b. Rungs shall penetrate inside wall of side rails.
      - 1) Do not extend rungs beyond the outside face of the side rail.
      - 2) Provide fillet weld all around rung at inside face of side rail and plug weld at outside face of side rail.

- c. Rung spacing:
    - 1) Equally spaced not less than 10 inches and not more than 14 inches as measured between the centerlines of the rungs.
      - a) Ladder rungs and steps in elevator shafts shall be spaced not less than 6 inches and not more than 16.5 inches as measured between the centerlines of the rungs.
    - 2) Top rung shall be level with landing or platform.
      - a) Where top of ladder terminates at grating cover, floor access door, roof hatch or similar condition; locate top rung as close as practicable to, but not more than 6 inches below, adjacent walking surface.
- 5. Brackets:
  - a. Angle or bent plate brackets welded to side rails:
    - 1) 3/8 inches by 2-1/2 inches by length required.
    - 2) Provide punched holes for 3/4 inches bolts or anchors.
    - 3) Minimum distance from centerline of rung to wall or any obstruction: 7 inches.
    - 4) Maximum spacing: 4 feet OC.
  - b. For floor supported ladders, provide 3/8 by 2-1/2 by 4 inches rectangular bracket or 3/8 by 6 by 6 inches square plate welded to rails with punched holes for 3/4 inches bolts.
    - 1) Provide wall brackets on floor supported units if vertical run is over 4 feet.
- 6. Landings:
  - a. Construct landing, railing and all supports of same material as the ladder.
  - b. Design live load for landing platform and supporting structure:
    - 1) 100 PSF, uniform load.
    - 2) 300 LBS concentrated load on 4 inches square area.
    - 3) All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
    - 4) Maximum deflection: 1/300 of span under a superimposed live load of 100 psf.
  - c. Grating:
    - 1) Per this Specification Section.
  - d. Structural support: Channel or tubular sections with bracing, plates, angles, etc., to support guardrail and grating and to support landing from the side of the structure.
    - 1) Weld or bolt all connections using stainless steel bolts, nuts and washers.
  - e. Guardrails:
    - 1) Match ladder side rails.
      - a) Space intermediate rails equally between top rail and top of kickplate.
    - 2) Provide 4 inches high x 3/8 inches thick toeboard each side of landing.
- B. Bollards:
  - 1. 8 inches diameter extra strength steel pipe, ASTM A53.
    - a. Galvanized.
- C. Abrasive Stair Nosings:
  - 1. Interior stairs:
    - a. Two component consisting of an embedded subchannel and an abrasive tread plate
    - b. Subchannel: 6063-T5 extruded aluminum.
      - 1) Complete with concrete anchors.
    - c. Finish: Mill.
  - 2. Length:
    - a. Concrete stairs and landings:
      - 1) 4 inches less than overall stair width.
      - 2) Where tread mounted railing post occurs, hold nosing back 4 inches clear from railing centerline.
    - b. Concrete filled metal pan stairs: Full length of tread.
    - c. Concrete landings at metal stairs: 4 inches less than clear width between stringers.
- D. Metal Stairs:

1. Treads: Grating as specified.
    - a. Provide integral corrugated non-slip nosing.
  2. Risers:
    - a. Grating treads:
      - 1) Solid plate welded to trailing edge of tread or landing.
      - 2) Minimum 3/16 inches thick by 4 inches high.
    - b. Checkered plate treads: Solid checkered plate riser integral with tread.
  3. Landings:
    - a. Grating as specified.
    - b. Provide integral corrugated non-slip nosing at edge acting as stair tread/nosing.
  4. Design live load for landing platform and supporting structure:
    - a. 100 PSF, uniform load.
    - b. 300 LBS concentrated load on 4 inches square area.
    - c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
    - d. Maximum deflection: 1/300 of span under a superimposed live load of 100 psf.
  5. Design, fabricate, and install in compliance with NAAMM and applicable codes.
    - a. NAAMM AMP 510:
      - 1) Exterior at site structures and equipment: Industrial Class.
      - 2) Interior or exterior at buildings: Service Class.
  6. Handrails and guardrails: Refer to Specification Section 05 52 43.
  7. Material:
    - a. Aluminum.
- E. Aluminum Grating:
1. NAAMM MBG 531.
  2. Bearing bars: Rectangular, 1-1/2 by 3/16 inches at 1-3/16 inches on-center spacing OR I-bar, 1-1/2 inches deep with minimum 1/16 inches thick bar and minimum 1/4 inches flange width at 1-3/16 inches on-center spacing (unless noted otherwise on Drawings).
  3. Cross bars:
    - a. Welded, swaged or pressure locked to bearing bars:
    - b. Maximum 4 inches/OC spacing.
  4. Top edges of bars: Grooved or serrated.
  5. Finish: Mill, standard.
  6. Clips and bolts: Stainless steel.
  7. Seat angles: Aluminum or stainless steel
- F. Heavy-Duty Castings, Trench Covers, and Accessories:
1. Prefabricated, cast iron ASTM A48.
  2. Design load: AASHTO HS-20 wheel loading for indicated span.
  3. Machine horizontal mating surfaces.
- G. Access Cover:
1. Tank type manhole frame and solid lid: ASTM A48 or ASTM A536, cast iron.
  2. Unless shown otherwise, design of cover shall be such that top of frame extends several inches above slab to prevent surface water from entering tank.
  3. Equip lid with four stainless steel screws to secure lid to frame.
- H. Modular Framing System:
1. Materials:
    - a. Steel: ASTM A1011, carbon steel, Grade 33.
      - 1) Hot-dipped galvanized, ASTM A123 or ASTM A153.
    - b. Aluminum: ASTM B221 or ASTM B209.
    - c. Stainless steel: ASTM A666.
    - d. Fiberglass: See Specification Section 06 82 00.
  2. Channels and inserts:
    - a. Steel or stainless steel: Minimum 12 GA.

- b. Aluminum: Minimum 0.080 inches.
  - c. Channels to have one side with a continuous slot with in-turned lips.
    - 1) Width: 1-5/8 inches.
    - 2) Depth and configuration as necessary for loading conditions.
- 3. Fittings: Same material as system major components.
- 4. Fasteners:
  - a. Nuts: Toothed grooves in top of nuts to engage the in-turned lips of channel.
  - b. Bolts: Hex-head cap screws.
  - c. Same material as system major components.
- 5. End caps:
  - a. At each exposed end of each piece mounted on walls, or guardrails, or suspended from framing 7 feet or less above the floor or platform.
    - a) Plastic for all exposed ends 7 feet or more above floor or platform.
    - b) Plastic or metallic for all other exposed ends.
- 6. Schedule:
  - a. Interior wet areas: Aluminum.
  - b. Interior corrosive areas: Stainless steel.
  - c. Exterior areas: Aluminum.
  - d. All other areas not listed above: Hot-dipped galvanized steel.
- 7. Repair all cut ends or otherwise damaged areas of galvanized steel in accordance with ASTM A780.

## 2.4 FABRICATION

- A. Verify field conditions and dimensions prior to fabrication.
- B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.
  - 1. Grind smooth all rough welds and sharp edges.
    - a. Round all corners to approximately 1/32 - 1/16 inches nominal radius.
- C. Provide drilled or punched holes with smooth edges.
  - 1. Punch or drill for field connections and for attachment of work by other trades.
- D. Weld Shop Connections:
  - 1. Welds to be continuous fillet type unless indicated otherwise.
  - 2. Full penetration butt weld at bends in stair stringers and ladder side rails.
  - 3. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1/A5.1M.
  - 4. Weld aluminum in accordance with AWS D1.2.
  - 5. Weld stainless steel in accordance with AWS D1.6.
    - a. Treat all welded areas in accordance with ASTM A380.
  - 6. All headed studs to be welded using automatically timed stud welding equipment.
  - 7. Grind smooth welds that will be exposed.
- E. Passivate stainless steel items and stainless steel welds after they have been ground smooth.
  - 1. ASTM A380.
- F. Conceal fastenings where practicable.
- G. Fabricate work in shop in as large assemblies as is practicable.
- H. Tolerances:
  - 1. Rolling:
    - a. ASTM A6.
    - b. When material received from the mill does not satisfy ASTM A6 tolerances for camber, profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the use of controlled heating and mechanical straightening, subject to the limitations of the AISC Specification.
  - 2. Fabrication tolerance:

- a. Member length:
  - 1) Both ends finished for contact bearing: 1/32 inches.
  - 2) Framed members:
    - a) 30 feet or less: 1/16 inches.
    - b) Over 30 feet: 1/8 inches.
- b. Member straightness:
  - 1) Compression members: 1/1000 of axial length between points laterally supported.
  - 2) Non-compression members: ASTM A6 tolerance for wide flange shapes.
- c. Specified member camber (except compression members):
  - 1) 50 feet or less: -0/+1/2 inches.
  - 2) Over 50 feet: -0/+1/2 inches (+1/8 inches per 10 feet over 50 feet).
  - 3) Members received from mill with 75% of specified camber require no further cambering.
  - 4) Beams/trusses without specified camber shall be fabricated so after erection, camber is upward.
  - 5) Camber shall be measured in fabrication shop in unstressed condition.
- d. At bolted splices, depth deviation shall be taken up by filler plates.
  - 1) At welded joints, adjust weld profile to conform to variation in depth.
  - 2) Slope weld surface per AWS requirements.
- e. Finished members shall be free from twists, bends and open joints.
  - 1) Sharp kinks, bends and deviation from above tolerances are cause for rejection of material.
- I. Fabricate grating, checkered plate, stairs, ladders and accessories using aluminum unless shown otherwise on Drawings.
  - 1. Finish:
    - a. Mill, unless noted otherwise.
    - b. Coat surfaces in contact with dissimilar materials.
- J. Fabricate grating in accordance with NAAMM MBG 531.
  - 1. Maximum tolerance for difference in depth between grating depth and seat or support angle depth: 1/8 inches.
  - 2. Distance between edge of grating and face of embedded seat angle or face of wall or other structural member: 1/4 inches.
    - a. Tolerance: NAAMM MBG 531.
  - 3. Removable sections: Not wider than 3 feet and not heavier than 100 pounds.
  - 4. Ends and perimeter edges: Banded, with alternate bearing bars welded to band.
    - a. Provide full depth banding unless noted otherwise.
    - b. Banding at trenches and sumps to be 1/4 inches less than grating depth to allow for drainage.
  - 5. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 inches high toe plate.
  - 6. Provide joints at openings between individual grating sections.
  - 7. Fabricate grating so that bearing bars and cross bars in adjacent sections are aligned.
- K. Fabricate checkered plate and miscellaneous metals in accordance with NAAMM AMP 555.
  - 1. Workmanship: Class 2 Class 1 unless noted otherwise.

## 2.5 SOURCE QUALITY CONTROL

- A. Surface Preparation:
  - 1. All miscellaneous metal fabrication item surfaces shall be inspected and approved by NACE certified coatings inspector prior to application of shop-applied coatings.
    - a. Inspection shall be performed to determine depth of blast profile and cleanliness of surface.
    - b. Fabricator shall reblast and or re-clean surfaces as required until acceptable.
- B. Shop Applied Coating Application:

1. After surface has been accepted in writing by NACE certified coatings inspector, fabricator may proceed with application of coatings.
  2. Application of coatings shall be observed and certified by NACE certified coatings inspector.
- C. Shop Inspection and Testing:
1. Owner will employ and pay for the services of a qualified independent testing agency to inspect and test all structural steel work for compliance with Contract Documents.
  2. Contractor responsible for testing to qualify shop and field welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
  3. Independent testing agency shall have a minimum of five years performing similar work and shall be subject to Owner's approval.
- D. Responsibilities of Testing Agency:
1. Inspect shop and field welding in accordance with AWS Code including the following non-destructive testing:
    - a. Visually inspect all welds.
    - b. In addition to visual inspection, test 50% of full penetration welds and 20% of fillet welds with liquid dye penetrant or mag particle.
    - c. Test 20% of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
  2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
    - a. Verify direct tension indicator gaps, if applicable.
  3. Inspect structural steel which has been erected.
  4. Inspect stud welding in accordance with AWS Code.
  5. Prepare and submit inspection and test reports to Engineer.
    - a. Assist Engineer to determine corrective measures necessary for defective work.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Provide items to be built into other construction in time to allow their installation.
1. If such items are not provided in time for installation, cut in and install.
- B. Prior to installation, inspect and verify condition of substrate.
- C. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
1. Field welding aluminum is not permitted unless approved in writing by Engineer.

### **3.2 INSTALLATION**

- A. Set metal work level, true to line, plumb.
1. Shim and grout as necessary.
- B. Contractor is solely responsible for safety.
1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
  2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, and diagonal bracing or rigid connections are installed.
  3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
  4. Until all elements of the permanent structure and lateral bracing system are complete, temporary bracing for the partially complete structure will be required.

- C. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including construction activities and operation of equipment is the responsibility of the Contractor.
  - 1. Plumb, align, and set structural steel members to specified tolerances.
  - 2. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.
  - 3. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
  - 4. Contractor shall be responsible for the design of the temporary bracing system and must consider the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades.
    - a. If not obvious from experience or from the Drawings, confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
  - 5. Remove and dispose of all temporary work and facilities off-site.
- D. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
  - 1. Report defects in work-in-place which may influence satisfactory completion of the work.
  - 2. Absence of such notification will be construed as acceptance of work-in-place.
- E. Field Measurement:
  - 1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
  - 2. Contractor responsible for the accurate fit of the work.
- F. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
  - 1. Use surveyor's level.
  - 2. Notify Engineer of any errors or deviations found by such checking.
- G. Framing member location tolerances after erection shall not exceed the frame tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
- H. Erect plumb and level; introduce temporary bracing required to support erection loads.
- I. Use light drifting necessary to draw holes together.
  - 1. Drifting to match unfair holes is not allowed.
- J. Welding:
  - 1. Comply with AWS D1.1, AWS D1.2, and AWS D1.6 (as applicable for the material welded) and requirements of this Section's "Fabrications" Article in "Part 2 - Products".
  - 2. When joining two sections of steel of different ASTM designations, welding techniques shall be in accordance with a qualified AWS D1.1 procedure.
- K. Shore existing members when unbolting of common connections is required.
  - 1. Use new bolts for rebolting connections.
- L. Clean stored material of all foreign matter accumulated prior to the completion of erection.
- M. Bolt Field Connections: Where practicable, conceal fastenings.
- N. Field Welding:
  - 1. Follow AWS procedures.
  - 2. Grind welds smooth where field welding is required.
- O. Field cutting grating or checkered plate to correct fabrication errors is not acceptable.
  - 1. Replace entire section.



- P. Remove all burrs and radius all sharp edges and corners of miscellaneous plates, angles, framing system elements, etc.
- Q. Unless noted or specified otherwise:
1. Connect steel members to steel members with 3/4 inches diameter ASTM F3125, Grade A325 high strength bolts.
  2. Connect aluminum to aluminum with 3/4 inches diameter stainless bolts.
  3. Connect aluminum to structural steel using 3/4 inches diameter stainless steel bolts.
    - a. Provide dissimilar metals protection.
  4. Connect aluminum and steel members to concrete and masonry using stainless steel mechanical anchor bolts or adhesive anchor bolts unless shown otherwise.
    - a. Provide dissimilar materials protection.
  5. Provide washers for all bolted connections.
  6. Where exposed, bolts shall extend a maximum of 3/4 inches and a minimum of 1/2 inches above the top of installed nut.
    - a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nuts.
- R. Install and tighten ASTM F3125, Grade A325 high-strength bolts in accordance with the AISC 325, Allowable Stress Design (ASD).
1. Provide hardened washers for all Grade A325 bolts.
    - a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.
- S. After bolts are tightened, upset threads of ASTM A307 bolts or anchor bolts to prevent nuts from backing off.
- T. Secure metal to wood with lag screws of adequate size with appropriate washers.
- U. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing.
1. Provide full penetration welded splices where continuity is required.
- V. Provide each fabricated item complete with attachment devices as indicated or required to install.
- W. Anchor such that work will not be distorted nor fasteners overstressed from expansion and contraction.
- X. Set beam and column base plates accurately on nonshrink grout as indicated on Drawings.
1. See Division 03 Specification Sections for non-shrink grout and anchorage.
  2. Set and anchor each base plate to proper line and elevation.
    - a. Use metal wedges, shims, or setting nuts for leveling and plumbing columns and beams.
      - 1) Wedges, shims and setting nuts to be of same metal as base plate they support.
      - 2) Tighten nuts on anchor bolts.
    - b. Fill space between bearing surface and bottom of base plate with nonshrink grout.
      - 1) Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.
    - c. Do not remove wedges or shims.
      - 1) Where they protrude, cut off flush with edge of base plate.
    - d. Fill sleeves around anchor bolts solid with non-shrink grout.
- Y. Tie anchor bolts in position to embedded reinforcing steel using wire.
1. Tack welding prohibited.
    - a. Coat projecting bolt threads and nuts with heavy coat of clean grease.
  2. Anchor bolt location tolerance:
    - a. Per Section 03 15 19.
- Z. Install bollards as detailed on Drawings.
1. Fill pipe with concrete and round off at top.

- AA. Provide abrasive stair nosings in each tread and landing of all concrete stairs and at each concrete stair landing having metal stair structure attaching to the concrete landing.
  - 1. Center stair nosings in stair width.
- BB. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor.
  - 1. Keep screw holes clean and ready to receive screws.
- CC. Attach grating to end and intermediate supports with grating saddle clips and bolts.
  - 1. Maximum spacing: 2 feet on-center with minimum of two per side.
  - 2. Attach individual units of aluminum grating together with clips at 2 feet on-center maximum with a minimum of two clips per side.
- DD. Repair damaged galvanized surfaces in accordance with ASTM A780.
  - 1. Prepare damaged surfaces by abrasive blasting or power sanding.
  - 2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions.
- EE. Anchor ladder to concrete structure with minimum 3/4 inches stainless steel anchor bolts with minimum 6 inches embedment.
- FF. Anchor ladder to masonry structure with minimum 3/4 inches stainless steel anchor bolts with minimum 6 inches embedment.
  - 1. When anchoring into masonry, fill masonry cores with grout at anchor locations and each masonry core within 8 inches of anchor
  - 2. When anchoring into cavity wall construction, provide minimum 6 inches embedment into concrete or masonry back-up wall.
    - a. At each anchor location, provide sleeve between back face of veneer and cavity face of concrete or masonry back-up wall.
    - b. Cut cavity insulation as required and seal around sleeve.
      - 1) Sleeve to be 1 inch diameter schedule 40 stainless steel tubing, TP-304L, ASTM A269.
        - a) Minimum wall thickness to be .065 inches.
      - 2) Continuously weld 4 by 4 by 1/4 inches Type 304 stainless steel, ASTM A666 flange onto each end of pipe.
        - a) Drill 1 inch hole in flange to match pipe.
        - b) Attach sleeve to concrete or masonry back-up with 1/4 inches concrete screw anchors.
      - 3) Grout solid, area around bolt where bolt penetrates veneer.
      - 4) Accurately locate sleeves to align with bolt locations on ladder.
- GG. Anchor ladder to metal stud walls using minimum 1/2 inches stainless steel bolts, nuts and washers.
  - 1. Verify that stud wall has been provided with adequate backing to accept ladder anchors.
- HH. Install ladder safety extension post in accordance with manufacturer's instructions.
  - 1. Mount device opposite the climbing side.
  - 2. Provide ladder safety extension device for all ladders unless noted otherwise.
- II. Mount ladder fall protection system with rail offset from ladder side rail approximately 3 inches.
- JJ. Install factory pre-fabricated stairs in location indicated in the Contract Documents and approved submittals.

### **3.3 FIELD QUALITY CONTROL**

- A. Tolerances (unless otherwise noted on the Drawings):
  - 1. Frame placement, after assembly and before welding or tightening.
    - a. Deviation from plumb, level and alignment: 1 inch 500, maximum.

- b. Displacement of centerlines of columns: 1/2 inches maximum, each side of centerline location shown on Drawings.
- B. Owner Pays for Field Inspection and Testing:
  - 1. Owner will employ and pay for services of an independent testing agency to inspect and test structural steel shop and field work for compliance with this Specification Section.
  - 2. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
  - 3. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

### **3.4 CLEANING**

- A. After fabrication, erection, installation or application, clean all miscellaneous metal fabrication surfaces of all dirt, weld slag and other foreign matter.
- B. All stainless steel products in addition to Paragraph A. above:
  - 1. Remove all heat tint, rusting, discoloration by passivation, ASTM A380, or other acceptable means as listed in NiDI 11 007 as approved by the Engineer.

**END OF SECTION**

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**SECTION 05 52 43**  
**WELDED ALUMINUM RAILINGS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Aluminum handrail, stair rail and guardrail.
  - 2. Aluminum guardrail gates.
  - 3. Aluminum Grating
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 05 50 00 - Metal Fabrications.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Aluminum Association (AA):
    - a. ADM 1, Aluminum Design Manual.
  - 2. American Society of Mechanical Engineers (ASME):
    - a. Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
  - 3. ASTM International (ASTM):
    - a. B108, Standard Specification for Aluminum-Alloy Permanent Mold Castings.
    - b. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
    - c. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
    - d. B247, Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
    - e. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
    - f. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
  - 4. American Welding Society (AWS):
    - a. C5.5, Recommended Practices for Gas Tungsten Arc Welding.
    - b. D1.2, Structural Welding Code - Aluminum.
  - 5. National Association of Architectural Metal Manufacturers (NAAMM):
    - a. AMP 521, Pipe Railing Systems Manual.
  - 6. U.S. Department of Justice, Architectural and Transportation Barriers Compliance Board (Access Board):
    - a. Americans with Disabilities Act (ADA):
      - 1) Accessibility Guidelines for Buildings and Facilities (ADAAG).
  - 7. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
- B. Qualifications:
  - 1. Qualify welding procedures and welding operators in accordance with AWS and ASME Section IX.

**1.3 DEFINITIONS**

- A. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.
- B. Handrail: A horizontal or sloping rail intended for grasping by the hand for guidance or support.

- C. Railing: A generic term referring to guardrail, handrail and/or stair rails.
- D. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

#### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Fabrication and/or layout drawings:
    - a. Drawings showing profile, location, sections and fabrication details including all welding information of each railing.
    - b. Type and details of anchorage.
    - c. Location and type of expansion joints.
    - d. Materials of construction, shop coatings and all third-party accessories.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation details.
  - 3. Certification that railings have been designed and fabricated to meet the loading requirements specified.
  - 4. Calculations:
    - a. Calculations shall be performed, sealed, signed and dated by a registered professional structural engineer licensed in the State of Maine.
    - b. Calculations shall be specific to this Project and shall include all assumptions, references and design interpretations used to achieve the results obtained by the Engineer.
    - c. Reduction in load criteria is not acceptable as reason for deviation from sizes indicated in the Specification.
- B. Informational Submittals:
  - 1. Certification of welders and welding procedures indicating compliance with AWS requirements.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Deliver and handle railings to preclude damage.
- B. Store railings on skids, keep free of dirt and other foreign matter which will damage railings or finish and protect against corrosion.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Welded railing systems:
    - a. Golden Railing - Welded Railing System.
    - b. Moultrie Manufacturing Company - Wesrail Welded.
    - c. Peak-to-Peak Engineered Railings - Welded Railing System.
    - d. Tuttle Railing Systems - TABCO 3000.

#### **2.2 MATERIALS**

- A. Alloy 6061-T6.
  - 1. ASTM B209 for sheets and plates.
  - 2. ASTM B221 and ASTM B308 for shapes - beams, channels, angles, tees, and zeeks.
  - 3. ASTM B247 for forgings.
- B. Alloy 6063-T5 or T6.

1. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
- C. Fittings:
  1. Cast Aluminum, ASTM B108.
  2. Machined aluminum: 6063-T5 or T6 alloy.
- D. Shims: Aluminum of same alloy as component being shimmed.
- E. Fasteners: See Specification Section 05 50 00.
- F. Expansion and Adhesive Anchors: See Specification Section 03 15 19.
- G. Electrodes for Welding:
  1. Aluminum: AWS D1.2.
  2. Filler alloy 5356 or 4043.

## 2.3 FABRICATION

- A. General:
  1. Verify field conditions and dimensions prior to fabrication.
  2. For fabrication of items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
    - a. Remove blemishes by grinding and buffing or by welding and grinding, prior to cleaning, treating and application of surface finishes.
  3. Form exposed work with smooth, short radius bends, accurate angles and straight edges.
    - a. Ease exposed edges to a radius of approximately 1/32 inches.
    - b. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
    - c. Drill or punch holes with smooth edges.
  4. Form exposed connections with flush, smooth, hairline joints, using stainless steel or aluminum splice locks to splice sections together or by welding.
    - a. Ease the edges of top rail splices and expansion joints and remove all burrs left from cutting.
  5. Provide for anchorage of type indicated on Drawings or as required by field conditions.
    - a. Drill or punch holes with smooth edges.
  6. Design railings and anchorage system in accordance with NAAMM AMP 521 to resist loading as required by the building code.
    - a. Maximum allowable stresses per AA ADM 1.
  7. Design railings in accordance with accessibility requirements per the building code and ADAAG.
- B. Custom fabricate railings to dimensions and profiles indicated.
  1. Guardrails:
    - a. Posts: Minimum 1 1/2 inches nominal diameter Schedule 80 pipe.
      - 1) Space vertical posts as required by loading requirements but not more than 4 feet on center.
      - 2) Avoid locating vertical posts at changes in direction of railing.
      - 3) Hold vertical post back from corner and provide radiused corners.
    - b. Rails: Minimum 1 1/2 inches nominal diameter Schedule 40 pipe.
      - 1) Where details are not indicated, space intermediate rails to requirements of the building code or OSHA Standards, whichever requires the more restrictive design.
  2. Handrail: Minimum 1 1/4 inches nominal diameter Schedule 40 pipe.
    - a. Outside diameter: 1 1/2 inches minimum, 2 inches maximum.
  3. Space handrail brackets as required by loading requirements but not more than 4 feet on center.
  4. Space vertical posts as required by loading requirements but not more than 4 feet on center.
  5. Space handrail brackets as required by loading requirements but not more than 4 feet on center.

6. Mounting:
  - a. Welded flanges:
    - 1) For surface mounting to top of concrete:
      - a) 3/8 x 6 x 6 inches square plate.
      - b) Predrilled to accept four anchors.
    - 2) For mounting to flange of metal structure:
      - a) 3/8 x 3 x 8 inches plate.
      - b) Predrilled to accept two fasteners.
  - b. Cast or machined flanges:
    - 1) Provide manufacturer's standard cast or machined flanges or brackets as necessary for conditions shown on Drawings.
    - 2) Railing posts shall be secured using socket-head stainless steel set screws.
      - a) Bolts, TEK screws, rivets, or adhesive are not acceptable.
    - 3) Flanges and brackets shall allow for removal of railing sections where removable railings are indicated on the Drawing.
  - c. Reinforce posts as necessary for loads specified.
    - 1) Completed assembly shall be designed to withstand the loading capacity specified.
7. Toeboards:
  - a. 1/4 inches thick by 4 inches high extruded toeboard with stiffener ribs.
    - 1) Wagner "IR94102" kickplate.
  - b. Guardrail gates:
    - 1) Constructed of same material and sizes as the guardrail system.
    - 2) Width of gate as shown on Drawings.
    - 3) Hinges:
      - a) Cast aluminum.
      - b) Self-closing.
        - (1) Stainless steel torsion spring.
      - c) Similar to Wagner, Model "IR100."
    - 4) Gate latch and stop:
      - a) Cast aluminum.
      - b) Spring-loaded pin latch.
        - (1) Stainless steel spring.
      - c) Similar to Wagner, Model "IR101."
- C. Railing Fabrication:
  1. Besides welded, rails and posts may be joined with stainless steel or aluminum fittings with stainless steel fasteners.
  2. All railings are to be welded systems.
  3. Use wire welding for all joints.
  4. All welding to be continuous in accordance with AWS C5.5 and AWS D1.2.
    - a. All welded railing joints shall have full penetration welds unless noted otherwise.
  5. All exposed welds to be ground smooth and flush to match and blend with adjoining surfaces.
    - a. NAAMM AMP 521, Type 2.
  6. No ragged edges, surface defects, or undercutting of adjoining surfaces will be accepted.
  7. Finishing joints with filler is not acceptable.
  8. Provide flush weld fittings using locking weld connectors or coped drive-on connectors.
  9. Fit exposed ends of guardrails and handrails with solid terminations.
    - a. Return ends of handrail to wall, but do not attach to wall.
    - b. Where guardrail terminates at a wall, provide a vertical post or end-loop 4 inches off the wall to center of vertical member.
  10. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly of units at project site.
  11. Provide weeps to drain water from hollow sections of railing at exterior and high humidity conditions.



- a. Drill 1/4 inches weep hole in railings closed at bottom:
    - 1) 1 inches above walkway surface at bottom of posts set in concrete.
    - 2) 1 inches above base flange or reinforcing spud where applicable.
    - 3) At low point of intermediate rails.
  - b. Do not drill weep holes:
    - 1) In bottom of base flange.
- 12. Expansion joints:
  - a. Joints to be designed to allow expansion and contraction of railing and still meet design loads required.
    - 1) Top rail splices and expansion joints shall be located within 8 inches of post or other support.
    - 2) Where railings span building expansion joints; provide a railing expansion joint in the span crossing the building expansion joint.
  - b. Provide expansion joints in any continuous run exceeding 20 feet in length.
    - 1) Space expansion joints at not more than 40 feet on center.
  - c. Provide minimum 0.10 inches of expansion joint for each 20 feet length of top rail for each 25 DEGF differential between installation temperature and maximum design temperature.
    - 1) Maximum expansion joint width at time of installation shall not exceed 3/8 inches.
      - a) Provide additional expansion joints as required to limit expansion joint width.
  - d. Provide slip-joint with internal sleeve.
    - 1) Extend slip joint min 2 inches beyond joint at maximum design width.
    - 2) Fasten internal sleeve securely to one side.
      - a) Provide Allen-head set screw located in bottom of rail.
      - b) Rivets or exposed screw heads are not acceptable.
- D. Finish:
  - 1. Mill.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Prior to installation, inspect and verify condition of substrate.
- B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
  - 1. Field welding aluminum is not permitted unless approved in writing by Engineer.

### **3.2 INSTALLATION**

- A. Install handrails and guardrails to meet loading requirements of the building code.
- B. Install products in accordance with manufacturer's instructions.
- C. Set work accurately in location, alignment and elevation; plumb, level and true.
  - 1. Measure from established lines and items which are to be built into concrete, masonry or similar construction.
- D. Align railings prior to securing in place to assure proper matching at butting and expansion joints and correct alignment throughout their length.
  - 1. Provide shims as required.
- E. Install proper sized expansion joints based on temperature at time of installation and differential coefficient of expansion of materials in all railings as recommended by manufacturer.
  - 1. Lubricate expansion joint splice bar for smooth movement of railing sections.
- F. Provide removable railing sections where indicated on Drawings.
- G. Attach handrails to walls or guardrail with brackets designed for condition:

1. Provide brackets which provide a minimum 1/4 inches clearance between handrail and nearest obstruction.
    - a. Handrails shall not project more than 4-1/2 inches into required stairway width.
  2. Anchor handrail brackets to concrete or masonry walls with stainless steel adhesive anchors with stainless steel hex head bolts.
  - 3.
- H. Anchor railings to concrete with stainless steel adhesive anchors with stainless steel bolts, nuts and washers unless noted otherwise in the Contract Documents.
1. Where exposed, bolts shall extend minimum 1/2 inches and maximum 3/4 inches above the top nut.
    - a. If bolts are cut off to required height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nut.
    - b. Bevel the top of the bolt after cutting to provide a smooth surface.
- I. Anchor railings to metal structure with stainless steel bolts, nuts and washers.
- J. Install toeboards to fit tight to the walking surface.
1. Attach to railing vertical post with manufacturer's standard mounting clamp:
    - a. Adjustable.
    - b. Designed to engage in extruded slot on back of toeboard.
  2. Provide splice bars, corner splices and brackets:
    - a. Manufacturer's standard items as required for a complete installation.
  3. Provide spacer bar and U-bracket where necessary for toeboard to clear mounting flange.
  4. Bottom of toeboard shall not exceed 1/4 inches above walking surface.
- K. Provide railings as required for stair construction identified in Specification Section 05 50 00.
- L. Install guardrail gate plumb and level in location shown on Drawings.
1. Center gate in opening.
  2. Top of gate to match top of guardrail.
  3. Fasten hinges to gate and jamb post:
    - a. Minimum three, 1/4 inches stainless steel countersunk machine screws per leaf.
    - b. Drill and tap into railing and gate vertical posts.
  4. Provide not less than two hinges per gate.
  5. Install gate latch and stop on strike side of opening.
    - a. Fasten to gate with 1/4 inches stainless steel countersunk machine screws.
    - b. Drill and tap into gate vertical post.
    - c. Drill hole in railing vertical post to receive latch pin.
  6. Adjust to provide smooth operation:
    - a. Self-closing and self-latching.

## END OF SECTION



## DIVISION 06

WOOD, PLASTICS, AND COMPOSITES



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## **SECTION 06 10 00**

### **ROUGH CARPENTRY**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Rough carpentry.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 05 50 00 - Metal Fabrications.
  - 4. Section 07 61 13 - Metal Roofing

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. The Engineered Wood Association (APA):
    - a. PRP-108, Performance Standards and Qualification Policy for Structural Use Panels.
    - b. U450E, Storage and Handling of APA Trademarked Panels.
    - c. Y510T, Plywood Design Specification.
  - 2. ASTM International (ASTM):
    - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - b. D2898, Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
    - c. D4442, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
    - d. D4444, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters.
    - e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 3. American Wood Protection Association (AWPA):
    - a. M2, Standard for Inspection of Wood Products Treated with Preservatives.
    - b. M3, Standard Quality Control Procedures for Wood Preserving Plants.
    - c. M4, Standard for the Care of Preservative-Treated Wood Products.
    - d. P5, Standard for Waterborne Preservatives.
    - e. U1, Use Category System: User Specification for Treated Wood.
  - 4. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
    - a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
  - 5. Environmental Protection Agency (EPA).
  - 6. FM Global (FM):
    - a. 1-49, Property Loss Prevention Data Sheets - Perimeter Flashing.
  - 7. National Institute of Standards and Technology (NIST):
    - a. PS-1, Construction and Industrial Plywood.
    - b. PS-20, American Softwood Lumber Standard.
  - 8. Truss Plate Institute Inc. (TPI):
    - a. 1 National Design Standard for Metal Plate Connected Wood Truss Construction.
    - b. HIB, Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses.
  - 9. Underwriters Laboratories, Inc. (UL):
    - a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.
  - 10. Building code:

- a. Maine Construction Code 2015 Edition including all amendments, referred to herein as Building Code.
- B. Qualifications:
  - 1. Wood Treatment Plant: AWP A M3.
  - 2. Treated Wood Inspection: AWP A M2.
- C. Miscellaneous:
  - 1. Factory marking:
    - a. Lumber:
      - 1) Identify type, grade, moisture content, inspection service, producing mill, and other qualities specified.
      - 2) Marking may be omitted, as allowed by Building Code, if certificate of inspection is provided for each shipment.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Fabrication drawings of all fabricated items.
  - 3. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions for all products specified.
  - 4. Certifications:
    - a. Chemicals used in treatment process are registered with and approved by EPA.
    - b. Moisture content of material prior to treatment: 25 PCT maximum.
    - c. Material has been kiln-dried after treatment (KDAT) to the moisture content specified.
  - 5. Documentation of treatment of treated material in accordance with standards referenced.
- B. Informational Submittals:
  - 1. Wood trusses:
    - a. Provide the following:
      - 1) Design criteria, span, depth, slope and spacing of all trusses.
      - 2) Minimum bearing width required by lumber in truss.
      - 3) Design dead, live and wind loads and any concentrated loads and their point of application.
      - 4) Species, grade, size and dimension of all lumber.
      - 5) Connection details and plating requirements.
      - 6) Bracing details and location.
      - 7) Letter of certification signed and stamped by structural engineer registered in State of Maine stating that wood trusses have been designed to meet the requirements of the Drawings, Specifications and the Building Code.
      - 8) Test results of connector plate lateral load evaluation to determine normal load values for design based on ultimate load and proportional limit value at 0.015 IN.
      - 9) Adjustments to metal connector plate and lumber design values.

### **1.4 DELIVERY AND STORAGE**

- A. Delivery, storage and handling of untreated wood products:
  - 1. Lumber: As recommended by the grading agency indicated on the grade stamp.
  - 2. Plywood: APA U450E.
- B. Delivery, storage, handling and disposal of treated wood products: AWP A M4.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Wood connectors:
    - a. Simpson Strong-Tie Company, Inc.
    - b. Southeastern Metals Manufacturing Company, Inc.
- B. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- C. Submit request for substitution in accordance with Specification Section 00 72 13.

### **2.2 MATERIALS**

- A. General:
  - 1. Lumber (for framing, blocking, nailers, furring, grounds and similar members):
    - a. NIST PS-20.
    - b. Species:
      - 1) Treated material: As indicated in the appropriate AWP standard.
      - a) Provide species of FRTM as necessary to achieve UL rating listed.
    - c. Grade:
      - 1) For nominal sizes up to and including 2 x 4: Standard and better.
      - 2) For nominal sizes up to 2 IN thick and wider than 4 IN: #2 and better.
  - 2. Structural plywood:
    - a. NIST PS-1, NIST PS-2.
    - b. APA PRP-108, APA Y510T.
    - c. Sheathing: Structural I Rated Sheathing:
      - 1) Exposure: EXT.
      - 2) Span rating: 24/0.
    - d. Underlayment
      - 1) All plywood furnished for a single span rating to be the same thickness.
      - 2) Thickness: As indicated on Drawings.
      - 3) Square edges.
  - 3. Non-structural plywood:
    - a. NIST PS-1.
    - b. C-D plugged:
      - 1) Exposure: EXP1.
      - 2) Thickness: As indicated on Drawings.
      - 3) Touch sanded.
  - 4. Moisture content:
    - a. Kiln-dry, ASTM D4442 and ASTM D4444.
    - b. Lumber: 19 PCT maximum.
    - c. Wood structural panels: 15 PCT maximum.
    - d. Plywood: 15 PCT maximum.
- B. Preservative Treated Material:
  - 1. Moisture content:
    - a. Prior to treatment: 25 PCT.
    - b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
      - 1) Lumber: 19 PCT maximum.
      - 2) Plywood: 18 PCT maximum.
  - 2. Preservative:
    - a. Waterborne: AWP P5.
    - b. As indicated in the appropriate AWP standard.
  - 3. Pressure-treat material in accordance with AWP U1.

4. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.
- C. Fasteners and Anchors:
1. Nails and screws:
    - a. Dry, non-corrosive exposure: Hot dipped galvanized or Type 304 stainless steel.
    - b. Wet, corrosive, marine, and/or below grade: Type 316 stainless steel.
  2. Adhesive anchors, expansion anchors, self-tapping concrete anchors, bolts, nuts, and washers: See Specification Section 05 50 00.
- D. Fascia Board and Miscellaneous Exterior Wood Trim: S4S clear redwood.
- E. Roof Trusses:
1. Lumber:
    - a. Species: Douglas fir or SPF.
    - b. Grade: #2 and better.
  2. Design trusses, connections, bracing, bridging and end bearings to resist loads shown on Drawings.
  3. Design and fabricate wood trusses to meet requirements of:
    - a. AF&PA NDS.
    - b. TPI 1.
    - c. Building Code.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Verify measurements, dimensions, and shop drawing details before proceeding.
- B. Coordinate location of studs, nailers, blocking, grounds and similar supports for attached work.
- C. Eliminate sharp projections which would puncture roofing, flashing or underlayment material.

### **3.2 ERECTION AND INSTALLATION**

- A. General:
  1. Provide preservative treated material for all wood used:
    - a. Outside building.
    - b. Below grade.
- B. Attach work securely by anchoring and fastening as indicated or required to support applied loading.
  1. Anchor wood to concrete using adhesive or expansion anchors as specified in Specification Section 05 50 00.
    - a. Separate wood from direct contact to concrete with polyethylene foam gasket strip.
      - 1) Size: 1/4 IN by width of wood member.
      - 2) Owens Corning "SillSealR".
  2. Anchor wood to metal using bolts and nuts as specified in Specification Section 05 50 00.
  3. Provide flat washers under all bolt heads and nuts.
  4. Fasten plywood in accordance with APA recommendations.
  5. Use fasteners of size that will not penetrate members where opposite side will be exposed to view or receive finish materials.
  6. Install fasteners without splitting of wood; predrill as required.
  7. Do not drive threaded friction type fasteners.
  8. Tighten bolts and lag screws at installation and retighten as required.
- C. Set work to required levels and lines, plumb, true.
  1. Shim as required.



2. Cut and fit accurately.
- D. Provide wood grounds, nailers, or blocking where required for attachment of other work and surface applied items.
1. Form to shapes indicated or required.
    - a. FRTM lumber:
      - 1) Do not rip or mill.
      - 2) Cross-cutting and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
      - 3) Resurfacing, planing or fabrication of special shapes or profiles shall be done prior to treatment.
    - b. FRTM plywood:
      - 1) Cross-cutting, ripping and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
    - c. Light sanding of FRTM as permitted by UL to remove raised grain or prepare for finishing is allowable.
    - d. Field treat cuts and holes in preservative treated material in accordance with AWWA M4 and manufacturer's published recommendations.
  2. Grounds:
    - a. Dressed, key beveled lumber minimum 1-1/2 IN wide of thickness required to bring face of ground even with finish material.
    - b. Remove temporary grounds when no longer required.
  3. Install roofing nailers as necessary for attachment of flashing, curbs, fascia, coping, and related accessories:
    - a. Match height of nailers to insulation.
    - b. Anchor nailers to resist force of 300 PLF unless required otherwise by FM Global or roofing manufacturer.
      - 1) Metal decking attachment:
        - a) Attach base nailer to metal roof deck using self-tapping stainless steel sheet metal screws (STSMS) with plate washers or with minimum 3/8 IN Type 304 stainless steel hex head bolts with nuts and washers.
        - b) Countersink heads of bolts flush with top of nailer.
      - 2) Provide size and spacing of anchorage as required to meet loading criteria specified.
        - a) Fasten blocking for perimeter flashing in accordance with ANSI/SPRI ES-1 and FM Global 1-49.
    - c. Provide 1/2 IN vent spaces between lengths of nailers.
    - d. Install nailers over vapor retarder.
- E. When wood has been exposed to moisture allow to completely dry out prior to covering with additional wood or another material.
- F. Correct or replace wood which shows bowing, warping or twisting to provide a straight, plumb and level substrate for applications of other materials.
- G. Wood Trusses:
1. Use care when handling so as not to subject trusses to excessive lateral bending.
  2. Erect trusses in accordance with recommendations of TPI HIB so as to be level, plumb and in correct location.
  3. Cutting and altering trusses is not permitted.
  4. Brace trusses sufficiently during construction to prevent toppling or dominoing prior to placing any load on trusses.
  5. Connect trusses to remainder of structure using wood connectors in accordance with details on drawings and manufacturers' recommendations.
  6. Provide bracing where required by truss designer.

**END OF SECTION**

**SECTION 06 17 53**  
**METAL PLATE CONNECTED WOOD TRUSSES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish labor, materials, tools, equipment, and services for Metal Plate Connected Wood Trusses, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

**1.2 QUALITY ASSURANCE**

- A. Fabricator Qualifications:
  - 1. Minimum five years experience in fabrication of metal-plate-connected wood trusses.
  - 2. Participate in a recognized quality-assurance program that involves inspection by SPIB; Timber Products Inspection.; Truss Plate Institute (TPI); or other independent inspection and testing agency acceptable to OWNER.
- B. Metal-Plate Connector Manufacturer Qualifications:
  - 1. Member of TPI and comply with TPI quality-control procedures for manufacture of connector plates.
  - 2. Provide metal connector plates from one source and by a single manufacturer.
- C. Erector Qualifications:
  - 1. Experienced in wood truss installation and shall have completed wood truss installation similar in material, design, and extent to that indicated on Drawings with a record of successful in-service performance.
- D. Truss Plate Institute (TPI):
  - 1. ANSI/TPI-1 National Design Standard for Metal-Plate-Connected Wood Truss Construction
  - 2. TPI Building Component Safety Information (BCSI) - Guide to Good Practice for Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses.
  - 3. TPI DSB Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses
- E. Reference Standards:
  - 1. National Institute of Standards and Technology DOC PS20 American Softwood Lumber Standard
  - 2. American Wood Council (AWC) National Design Specification for Wood Construction.
- F. Provide trusses engineered by specialty structural engineer to support superimposed dead, live, and lateral, wind or seismic, loads indicated.
  - 1. Include truss to truss girder connection design.
  - 2. Include handling forces and show temporary bracing required during erection.
  - 3. Proportion such that the following deflection limits are not exceeded:
    - a. Live or snow: Span /360.
    - b. Dead (including long term deflection) plus live or snow: span/240.
    - c. Wind: Span/360.
- G. OWNER to review design for general conformance with intent of Contract Documents.

### 1.3 SUBMITTALS

- A. Shop Drawings:
  - 1. Indicate location, pitch, span, camber, configuration, and spacing for each type of truss required; species, sizes, and stress grades of lumber to be used; splice details; type, size, material, finish, design values, and orientation and location of metal connector plates; truss to truss girder connection details and truss bearing details.
  - 2. Indicate permanent bracing required including location, size, and connection details.
  - 3. Provide signed and sealed calculations for permanent bracing.
- B. Product Data:
  - 1. Product certificates signed by officer of truss fabrication firm certifying that metal-plate-connected wood trusses supplied comply with specified requirements and shop drawings.
  - 2. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by American Lumber Standards Committee (ALSC) Board of Review.
  - 3. Research or evaluation reports acceptable to authorities having jurisdiction that metal-plate connectors and metal-framing connectors comply with local building code.
- C. Project Information:
  - 1. Proof that erector has minimum of five (5) years experience in installation of metal-plate-connected wood trusses.
  - 2. Proof of fabricators participation in a recognized quality-assurance program.
  - 3. Engineering analysis and calculations indicating design moments, shears, and other forces signed and sealed by Specialty Structural Engineer.
    - a. Submit concurrent with Shop Drawings.
- D. Contract Closeout Information:
  - 1. Certificate by erector, that trusses were installed in accordance with approved erection plans and specifications.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Metal Connector Plates:
  - 1. Base:
    - a. Alpine Engineered Products.
    - b. Mitek Industries.
    - c. Tee-Lok.
    - d. Truswal Systems.
- B. Metal Framing Anchors:
  - 1. Base:
    - a. United Steel Products.
- C. Other manufacturers desiring approval comply with Section 00 72 13.

### 2.2 MATERIALS

- A. Dimensional lumber: Comply with DOC PS20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.
  - 1. Inspection agencies, and abbreviations used to reference them, include following:
    - a. NELMA Northeastern Lumber Manufacturers Association.
    - b. NLGA National Lumber Grades Authority.
    - c. SPIB Southern Pine Inspection Bureau.
    - d. WCLIB West Coast Lumber Inspection Bureau.
    - e. WWPA Western Wood Products Association.

2. Provide lumber with each piece factory marked with grade stamp of inspection agency, evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing and mill.
  3. Provide dressed lumber, S4S, manufactured to actual sizes required by DOC PS20 with 19 PCT maximum moisture content at time of dressing.
  4. Provide dimension lumber of any species for truss chord and web members, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values.
- B. Nails, wires, brads, and staples: Comply with ICC-ES AC233.
- C. Power driven fasteners: Comply with ICC ESR-1078.
- D. Metal framing anchors: Type, size, metal, and finish indicated.

## **2.3 FABRICATION**

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate connector plates from hot-dipped galvanized sheet steel complying with ASTM A653, G60; Grade-33 and not less than 0.0359 IN 1 MM thick.
- C. Fabricate metal connector plates to size, configuration and thickness required to withstand design loadings for types of joint designs indicated.
- D. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances of ANSI/TPI-1.
  1. Position members to produce design camber indicated.
- E. Connect truss members by metal connector plates located and securely embedded simultaneously into both sides of wood members by air or hydraulic press.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Consider that full structural capacity of trusses is not realized until structural assembly is complete.
  1. Until permanent elements of roof are complete, temporary bracing will be required. Install truss bracing according to recommendations of TPI and as indicated by truss fabricator.
  2. Do not install wood trusses until supporting construction is in place and braced.
- B. Splice trusses delivered to project site in more than one piece before installing.
- C. Install trusses plumb, square and true to line, and securely fasten to supporting construction.
- D. Space, adjust, and align trusses in location before permanently fastening. Space trusses not more than 24 IN 600 MM OC.
- E. Anchor trusses securely at bearing points using metal framing anchors. Install fasteners through each fastener hole in metal framing anchor according to manufacturer's fastening schedule and written instructions.
- F. Securely connect each truss ply for forming built-up girder trusses.
- G. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
- H. Install wood trusses within tolerances of ANSI/TPI-1.
- I. Do not cut or remove truss members.
- J. Do not alter trusses in field.

- K. Repair damaged galvanized coatings with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

**END OF SECTION**

**SECTION 06 82 00**  
**MATS & FIBERGLASS REINFORCED PLASTIC FABRICATIONS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Rubber mats.
  - 2. Fiberglass reinforced plastic (FRP) fabrications including but not limited to:
    - a. Solid plate.
    - b. Railings.
    - c. Grating.
    - d. Stairs.
    - e. Ladders.
    - f. Structural members.
    - g. Supporting structure design.
- B. Related Specification Sections include but are not necessarily limited to:

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American National Standards Institute (ANSI):
    - a. A14.3, Safety Requirements for Fixed Ladders and Workplace Surfaces Package.
  - 2. ASTM International (ASTM):
    - a. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 3. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

**1.3 DEFINITIONS**

- A. Skid-resistant:
  - 1. Manufacturer's standard applied abrasive grit coating.
  - 2. Abrasive coated tape is not acceptable.
- B. FRP: Fiberglass Reinforced Plastic.
- C. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.
- D. Handrail: A railing provided for grasping with the hand for support.
- E. Railing: A generic term referring to guardrail, handrail and/or stair rails.
- F. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

**1.4 SYSTEM DESCRIPTION**

- A. All fiberglass reinforced plastic support systems shall be designed by a registered professional structural engineer licensed in the State of Maine.

**1.5 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:

- a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Manufacturer's recommendations on reinforcing field cut openings.
  - 2. Fabrication and/or layout drawings.
    - a. Plan showing profile, location, section and details of each item including anchorage or support system(s).
    - b. Locations and type of expansion joints.
    - c. Materials of construction including shop applied coatings.
    - d. Listing of all accessory items being provided indicating material, finish, etc.
  - 3. Certifications:
    - a. Certification of Structural Engineer's qualifications.
    - b. Certification that all components and systems have been designed and fabricated to meet the loading requirements specified.
  - 4. Manufacturer's full line of colors available for each component.
- B. Informational Submittals:
- 1. Complete design calculations of all supporting structure and fastening conditions.
    - a. Design calculations to be for information only.
    - b. Engineer will not review or take any action on submittal.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and handle each item to preclude damage.
- B. Store all items on skids above ground.
  - 1. Keep free of dirt and other foreign matter which will damage items or finish and protect from corrosion and UV exposure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - a. Seasafe, Inc.
- 2. Rubber Mats
  - a. Rubber Sheet Warehouse – V-Groove Corrugated Matting
- 3. Grating and solid plate:
  - a. American Grating.
  - b. Enduro Composites.
  - c. Fibergrate Composite Structures, Inc.
  - d. Harsco Industrial IKG.
  - e. International Grating Inc.
  - f. Mona Composites.
  - g. Seasafe, Inc.
  - h. Strongwell Corporation.
- 4. Structural shapes:
  - a. American Grating.
  - b. Enduro Composites.
  - c. Fibergrate Composite Structures, Inc.
  - d. Mona Composites.
  - e. Strongwell Corporation.

### **2.2 MATERIALS**

- A. Rubber Mats
  - 1. Anti-slip rubber runner mats covering FRP grating. Black, 1/8" thick, 4-ft wide with closely spaced 'V' grooves.



- B. Fiberglass Reinforced Plastic (FRP):
  - 1. Vinyl ester with fiberglass reinforcing.
    - a. Type V.
  - 2. Fire retardant.
    - a. Flame spread: ASTM E84, 25 or less.
  - 3. Color: To be selected by Engineer when more than one color is available for any one component.
- C. Fasteners, Clips, Saddles, and Miscellaneous Components:
  - 1. Fiberglass where possible.
  - 2. Stainless steel may be used if fiberglass component is not available.
- D. Adhesive: Recommended by manufacturer.
- E. Skid-resistant Surfacing: Manufacturer-applied abrasive grit coating.

## 2.3 FABRICATION

- A. General:
  - 1. Verify field conditions and dimensions prior to fabrication.
  - 2. Preassemble items in shop to greatest extent possible.
  - 3. All components shall be treated with UV inhibitor.
  - 4. Drill or punch holes with smooth edges.
- B. Railings:
  - 1. Custom fabricate handrail and guardrail to profiles and dimensions indicated on Drawings.
  - 2. Where not indicated on Drawings, set intermediate horizontal rails to requirements of the building code.
  - 3. Minimum 2 inches SQ x 0.187 inches tube.
  - 4. Kickplate:
    - a. 4 x 1/2 inches (corrugated) x 0.125 inches thick.
    - b. Provide at all elevated platforms and where required by OSHA Standards.
  - 5. Provide handrail supports at 4 feet maximum spacing for wall brackets and 4 feet maximum spacing for posts.
    - a. Provide vertical supports at 4 feet maximum spacing on all inclined rail sections.
    - b. Provide brackets which provide a 1-1/2 inches projection from finish wall surface or guardrail to wall or guardrail side of rail.
    - c. Handrails shall not project more than 4-1/2 inches into required stairway width.
  - 6. Fit exposed ends of guardrails and handrails with solid terminations.
    - a. Return ends of handrail to wall but do not attach end to wall.
    - b. Where guardrail terminates at a wall or other obstruction, provide a vertical support post located 4 inches off wall or obstruction to center of post.
  - 7. Design railings to resist loading as required by the building code.
  - 8. Form connections with flush, smooth, hairline joints.
    - a. Provide concealed splice fitting at all connections.
    - b. Top rail splices and expansion joints shall be located within 8 inches of support.
  - 9. Fabricate items free of blemishes, seam marks, roller marks, rolled trade names and roughness.
  - 10. Provide removable railing where indicated.
  - 11. Provide weeps to drain moisture from hollow railing sections at exterior and in high humidity areas.
    - a. 1/4 inches weep hole in railing 1 inch above walkway surface at bottom of posts set in concrete or otherwise closed at bottom, and at other low points where moisture can collect.
- C. Grating and Solid Plate Material:
  - 1. Design live load:
    - a. 100 psf uniform live load.

- b. 300 pounds concentrated load.
    - c. Maximum deflection of 1/300 of span under a superimposed live load.
    - d. Design for the most severe loading condition noted above.
  - 2. Minimum grating depth: 1-1/2 inches.
  - 3. Bar span: Maximum of 1-1/2 inches center to center.
  - 4. Walking surface: Manufacturer's standard applied abrasive grit coating.
- D. Embedded Grating Supports:
- 1. Fiberglass.
  - 2. Size to suit depth of grating.
  - 3. Provide leg or strap for embedding and anchoring into concrete.
  - 4. Similar to Strongwell "Duradek Fiberglass Curb Angle."
- E. Stairs:
- 1. Fabricated to profiles indicated.
  - 2. Treads: Grating with integral 1 inch skid-resistant nosing.
    - a. Provide center reinforcing for treads over 36 inches wide.
  - 3. Risers:
    - a. Solid plate material to match treads.
    - b. Provide center vertical reinforcing for risers over 36 inches wide.
  - 4. Landings:
    - a. Grating with manufacturer's standard applied skid-resistant abrasive grit coating.
      - 1) Provide skid-resistant nosing on leading edge of stairs.
    - b. Provide intermediate support as required to meet loading requirements.
  - 5. Design and fabricate stair, platforms and landings, and all connections to support a 100 psf uniform live load plus a 300 psf concentrated load.
  - 6. Provide railing per this Specification Section.
- F. Ladders:
- 1. Design in accordance with ANSI A14.3, OSHA Standards and building code requirements unless noted otherwise below.
  - 2. Ladders shall be designed to support a minimum 300 pound concentrated vertical load with 150 pound concentrated horizontal load without failure or permanent set.
    - a. Maximum lateral deflection: Side rail span/300.
  - 3. Rungs:
    - a. 1 inches square or diameter solid bar with skid-resistant surface on all sides.
    - b. Uniform maximum spacing of 12 inches.
    - c. Top rung level with top of platform.
    - d. Rungs shall not extend beyond the outside face of the ladder side rail.
  - 4. Rails:
    - a. 2 inches SQ tube, minimum 0.156 inches thick.
    - b. Provide minimum 1/2 x 2-1/2 inches x length required standoff brackets on each side rail with punched holes for 3/4 inches anchors.
      - 1) Maximum vertical spacing: 5 feet on-center.
    - c. The side rails of through ladder extensions shall extend 42 inches above the top rung or landing and shall flare out on each side to provide a clearance of 24 inches between the rails.
  - 5. Minimum distance from centerline of rungs to wall or obstruction shall be 7 inches.
- G. Modular Framing System:
- 1. Material: Heavy duty pultruded.
  - 2. Shapes as required for condition.
  - 3. Fasteners: Stainless steel or fiberglass.
  - 4. Provide end caps for all exposed terminations.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Place rubber mat seams in inconspicuous locations to avoid tripping hazards. Avoid small and narrow cuts.
- B. Install products in accordance with manufacturer's instructions.
- C. Set work accurately in location, alignment and elevation, plumb, level, and true.
  - 1. Measure from established lines and levels.
  - 2. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
  - 3. Tolerances:
    - a. Maximum variation from plumb in vertical line: 1/8 inches in 3 feet.
    - b. Maximum variation from level of horizontal line: 1/4 inches in 20 feet.
    - c. Maximum variation from plan location: 1/4 inches in 20 feet.
- D. Coat all exposed surfaces of stainless steel fasteners with minimum 15 mil gel coating to match component being anchored.
- E. Attach grating to each end and intermediate support clip or saddle with bolts, nuts and washers.
  - 1. Maximum spacing: 2 feet on-center with minimum of two per side.
  - 2. Attach clips or saddles to bearing bars only.
  - 3. Reinforce all field cut openings in accordance with manufacturer's recommendations.
- F. File cut ends of all fiberglass to a 1/32 inches radius.
- G. Seal cut ends of all items with catalyzed resin as recommended by manufacturer.
  - 1. Provide same resin used in fabrication of item as a minimum.

### **END OF SECTION**

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## **SECTION 06 85 14**

### **FRP WEIRS AND BAFFLES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes: Fiberglass Reinforced Plastic (FRP) weir plates, baffles, mounting equipment and appurtenances.
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 46 43 22 - Circular Clarifier Equipment.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Water Work Association (AWWA):
    - a. F101, Contact-Molded, Fiberglass-Reinforced Plastic Wash-Water Troughs and Launderers, latest edition.
    - b. F102, Matched-Die Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles and Mounting Brackets, latest edition.
  - 2. National Sanitation Foundation/American National Standards Institute (NSF/ANSI):
    - a. 61, Drinking Water System Components - Health Effects.
- B. Qualifications:
  - 1. Manufacturer's Qualifications: Manufacturer shall have experience in designing and manufacturing FRP launders, weirs and baffles of similar size and configuration to those specified herein. For the manufacturer to be determined acceptable for providing these products on this project, they must show evidence of a minimum of five installations and five years experience in the design and manufacturer of FRP launders, weirs and baffles of similar size and type as specified herein.

##### **1.3 SYSTEM DESCRIPTION**

- A. The FRP products specified in this section shall be designed, manufactured and supplied by a single manufacturer.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Acknowledgement that products submitted meet requirements of the AWWA standards referenced.
  - 2. Certified drawings showing dimensions, project specific layout drawings, construction details and materials used for fabrication.
  - 3. Information and instructions for the storage, handling, installation and inspection of the products.
  - 4. Factory test results.

##### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store and handle the products in accordance with the manufacturer's recommendations.

#### **PART 2 - PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. ClearStream

2. Kusters Water
3. Walker Process Equipment
4. Warminster Fiberglass Company.
5. NEFCO.
6. MFG Water Treatment Products.

## **2.2 MATERIALS, PERFORMANCE AND DESIGN REQUIREMENTS**

- A. Weirs, Baffles and Mounting Plates:
  1. Comply with AWWA F101 and F102 except as modified herein.
  2. Products shall comply with NSF/ANSI 61, Drinking Water System Components – Health Effects and the Safe Drinking Water Act.
  3. Application (liquid): Aquaculture Waste Water.
  4. Application (process): Drumfilter effluent.
  5. Operating temperature range when in service: 31 degrees F to 75 degrees F.
  6. Operating temperature range when out of service: -11 degrees F to 85 degrees F.
  7. FRP products shall be Type 1 fabrications.
  8. FRP products shall be aqua in color.
  9. FRP products shall incorporate ultraviolet stabilizers.
- B. Requirements Specific to Weirs and Baffles:
  1. Flow conditions:
    - a. Clarifiers:
      - 1) Flow capacity at peak flow conditions: 175 GPM in a 19 foot diameter Clarifier.
      - 2) Flow capacity at average day conditions: 50 GPM in a 19 foot diameter Clarifier.
      - 3) Flow capacity at minimum conditions: 0 GPM in a 19 foot diameter Clarifier .
  2. The weir and baffle types and dimensional information are shown on the Drawings.

## **2.3 ACCESSORIES**

- A. Attachment hardware shall be 316 stainless steel and supplied by the manufacturer.

## **2.4 SOURCE QUALITY CONTROL**

- A. Factory Testing:
  1. Conduct physical property tests in accordance with AWWA F101 and F102.
  2. Conduct chemical-resistance property test in accordance with AWWA F101 and F102.
  3. Materials or products that fail to comply with the testing requirements shall be rejected and replaced, and not shipped to the project site. Re-fabrication and retesting shall be at manufacturer's expense.
- B. Factory Inspection:
  1. Owner or Engineer shall be allowed to inspect the FRP fabrication process and witness the factory testing. Provide a minimum of two weeks' notice to Owner prior to scheduling the factory testing.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION AND DELIVERY**

- A. Comply with requirements of AWWA F101 and F102.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.

### **3.3 FIELD QUALITY CONTROL**

- A. Launderers, weirs and baffles shall be carefully aligned and leveled to the elevations shown on the Drawings. In the completed installation, no variation greater than 1/8 inches shall exist between any two notches of the weir plate. In addition, the average deviation from one quadrant of the

weir to any other shall not exceed 1/16 inches. Weir elevation shall be verified once the tank is filled.

**END OF SECTION**

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## DIVISION 07

THERMAL AND MOISTURE PROTECTION



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**SECTION 07 13 26**  
**SELF-ADHERING SHEET MEMBRANE WATERPROOFING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish labor, materials, tools, equipment, and services for Self-Adhering Sheet Membrane Waterproofing, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

**1.2 QUALITY ASSURANCE**

- A. Apply waterproofing to exterior of walls below grade including exterior of walls surrounding elevator pits and other areas having lowered floor slabs.
- B. ASTM International (ASTM):
  - 1. ASTM D412 Standard Test Methods for Rubber Properties in Tension.
  - 2. ASTM D570 Standard Test Method for Water Absorption of Plastics.
  - 3. ASTM D903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
  - 4. ASTM D1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
  - 5. ASTM D3767 Standard Practice for Rubber - Measurements of Dimensions.
  - 6. ASTM D5385 Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
  - 7. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
  - 8. ASTM E154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- C. Applicator Qualifications:
  - 1. Not less than five similar sized projects with material specified.

**1.3 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturers' product data sheets, details and installation instructions including components and accessories, indicating product used to be in compliance with specifications.
- B. Project Information:
  - 1. Manufacturer certification of installer qualifications.
  - 2. Product test reports from qualified independent testing agency evidencing compliance of waterproofing with physical properties and other requirements based on comprehensive testing in accordance with specified test methods within previous five years.
  - 3. Minutes of Preinstallation Conference.
- C. Contract Closeout Information:
  - 1. Warranty.

**1.4 WARRANTY**

- A. Provide written five year material warranty signed by manufacturer for waterproof integrity.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Self-Adhering Sheet Membrane Waterproofing:
  - 1. Base:

- a. Henry Company
2. Optional:
  - a. Carlisle Coatings and Waterproofing Incorporated
  - b. Grace Construction Products
  - c. Polyguard Products, Inc.
  - d. W. R. Meadows.

B. Submit request for substitution in accordance with Specification Section 00 72 13.

## 2.2 MATERIALS

A. Self-Adhering Sheet Membrane Waterproofing:

1. Self-adhesive rubberized asphalt composite sheet membrane:
  - a. Total minimum thickness: 60 MIL 1.5 MM thick, composite sheet consisting of:
    - 1) Minimum 56 MIL 1.4 MM thick rubberized asphalt membrane laminated to;
    - 2) Minimum 4 MIL 0.1 MM thick cross-laminated polyethylene film with release liner on adhesive side.
  - b. Base Product: Henry Blueskin WP 200.
2. Sheet shall be formulated for use with ambient and substrate temperatures at time of installation, and for use with primer or surface conditioner complying with VOC limits of authorities having jurisdiction.
3. Provide waterproofing complying with following physical properties:

Physical Properties		
Property	Test Method	Typical Value
Film Thickness	ASTM D3767	60 mils 1.5 MM
Low Temperature Flexibility	ASTM D1970	Unaffected at -45 DEGF -45 DEGC
Elongation	ASTM D412	>300 PCT
Tensile Strength, Film	ASTM D412	325 PSI 2240 kPa minimum
Peel Adhesion to Concrete	ASTM D903	9.0 LBS/IN 1.75 MM
Resistance to Hydrostatic Head	ASTM D5385	231 FT 61 M minimum
Puncture Resistance	ASTM E154	50 LBS 27 kg minimum
Permeance	ASTM E96	0.02 perms 2.86 ng/m <sup>2</sup> /Pa
Water Absorption	ASTM D570	<0.1 PCT

4. Surface primer:
  - a. Liquid primer recommended by manufacturer of sheet waterproofing material for substrate and application temperatures.
5. Sheet flashing:
  - a. Self-adhering, polymer-modified rubberized-asphalt composite sheet of same material, construction, and thickness as waterproofing sheet membrane.
6. Liquid membrane:
  - a. Elastomeric, 2-component, liquid, cold fluid-applied, trowel grade, or low viscosity as recommended by waterproofing manufacturer for application.
7. Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.
8. Penetration seal:
  - a. Self-adhering reinforced membrane, 2-1/2 IN 64 MM wide, with a tack-free protective adhesive coating on 1 side and a release film on self-adhering side.

B. Protection Course Fabric:

1. Vertical applications:
  - a. CCW 200V.
  - b. 2-Ply polyester fabric.

C. Rigid Board Insulation: Specified in Section 07 21 00.

- D. Rigid cellular extruded polystyrene board complying with ASTM C578 for following type and requirements:
  - 1. Vertical Applications:
    - a. Type VI, 1.8 PCF 29 kg/m<sup>3</sup> minimum density and 40 PSI 275 kPa minimum compressive strength.
  - 2. Horizontal Applications:
    - a. Type V, 3.0 PCF 48 kg/m<sup>3</sup> minimum density and 100 PSI 690 kPa minimum compressive strength.
    - b. Type VII, 2.2 PCF 35 kg/m<sup>3</sup> minimum density and 60 PSI 415 kPa minimum compressive strength.
- E. Fabric faced rigid cellular polystyrene board complying with ASTM C578 for following type and requirements, and provided with fabricated tongue-and-groove edges and with one side having a matrix of vertical and horizontal drainage channels faced with non-woven filtration fabric:
  - 1. Flow rate: Minimum 10 GPM/FT 2 L/s/m at a hydraulic gradient of 1.0 and 1500 PSF 72 kPa normal pressure when tested in accordance with ASTM D4716.
    - a. Vertical Applications:
      - 1) Type IV, 1.6 PCF 25 kg/m<sup>3</sup> minimum density and 25 PSI 170 kPa minimum compressive strength.
      - 2) Type VI, 1.8 PCF 29 kg/m<sup>3</sup> minimum density and 40 PSI 275 kPa minimum compressive strength.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Cure concrete to moisture content acceptable to waterproofing manufacturer.
  - 1. Verify substrate is visibly dry and free of moisture.
  - 2. Test for capillary moisture by plastic sheet method according to ASTM D4263.
- B. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- C. Clean, prepare and treat substrate according to manufacturer's written instructions, to provide clean, dust-free, and dry substrate for waterproofing application.
- D. Mask off adjoining surfaces not receiving waterproofing to prevent spillage affecting other construction.
- E. Prime as recommended by manufacturer.
- F. Install in accordance with manufacturer's instructions.

### **3.2 MEMBRANE INSTALLATION**

- A. Construction joint, control joints, cracks and voids exceeding 1/16 IN 1.5 MM:
  - 1. Fill with liquid membrane and install 8 IN 200 MM membrane strip.
- B. Expansion Joints:
  - 1. Where anticipated movement is less than 1/2 IN 13 MM, install 3-ply membrane system as recommended by manufacturer.
- C. Vertical Inside and Outside Corners:
  - 1. Prepare, prime, and treat inside corners according to waterproofing manufacturer's instructions.
  - 2. Install 12 IN 300 MM membrane strip centered over vertical corners.
- D. Horizontal inside corners including foundation wall to footing intersections:
  - 1. Prepare, prime, and treat inside corners according to waterproofing manufacturer's instructions.

2. Install 3/4 IN 19 MM fillets of liquid membrane.
  3. Extend liquid membrane each direction from corner or install membrane strip centered over corner.
- E. Horizontal outside corners:
1. Prepare and treat outside corners according to waterproofing manufacturer's instructions.
  2. Apply double layer overlapping membranes.
- F. Drains:
1. Apply a double layer of membrane extending 12 IN 300 MM beyond drain.
  2. Install field sheet centered over drain.
- G. Pipes, posts, conduits, and similar penetrations:
1. Apply a double layer of membrane extending out at least 6 IN 150 MM from the penetrating item.
  2. Seal with mastic or liquid membrane product.
  3. Coordinate detailing at penetrations made after waterproofing system is complete with subcontractors responsible for penetrations.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at protrusions according to waterproofing manufacturer's instructions.
1. At top of wall conditions: Terminate membrane below final grade.
    - a. Apply mastic to terminations and joints.

### **3.3 SELF-ADHERING COMPOSITE SHEET APPLICATION**

- A. Install self-adhering composite sheet according to waterproofing manufacturer's written instructions.
- B. Apply primer to substrate at required rate.
1. Limit priming to areas that will be covered by waterproofing membrane in same day.
  2. Re-prime areas exposed for more than 24 HRS.
- C. Apply and firmly adhere sheet membrane over area to receive waterproofing:
1. Accurately align sheets and maintain uniform 2-1/2 IN 64 MM minimum lap widths and end laps.
  2. Overlap and seal seams and stagger end laps to ensure watertight installation.
  3. Install from low point to high point to ensure proper lap direction.
  4. Roll laps of membrane installed on vertical surfaces, and roll membrane on sloping and horizontal surfaces.
- D. Apply continuous sheet membrane over membrane strips bridging each type of joint to dimensions required by manufacturer.
- E. Seal exposed edges of membrane terminations.
- F. Install sheet membrane and auxiliary materials to tie in adjacent waterproofing.
- G. Repair tears, voids, and lapped seams in waterproofing not meeting requirements.
1. Slit and flatten fish mouths and blisters.
  2. Patch with sheet membrane extending 6 IN 150 MM beyond repaired areas.
- H. Waterproofing membrane must not be left exposed to construction traffic or ultraviolet rays without protection.

### **3.4 PROTECTION COURSE INSTALLATION**

- A. Install protection course over waterproofing membrane using tape or adhesive according to manufacturer's written instructions and before commencing subsequent construction operations.
- B. Do not penetrate waterproofing, and do not use stick clips to install protection course.
- C. Minimize exposure of membrane

### **3.5 PROTECTING AND CLEANING**

- A. Protect waterproofing from damage and wear during application and remainder of construction period, according to manufacturer's written instructions.
- B. Protect installed system from damage due to ultraviolet light exposure, physical abuse, and other causes.
  - 1. Provide temporary coverings where system will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

### **END OF SECTION**

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## **SECTION 07 21 00**

### **BUILDING INSULATION**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Building insulation.
    - a. Does not include roof insulation or roof vapor retarder; see Specification Section 07 61 13.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 04 05 23 - Masonry Accessories.
  - 4. Section 04 22 00 - Concrete Masonry.
  - 5. Section 06 17 53 - Metal Plate Connected Wood Trusses.
  - 6. Section 07 13 26 - Self-Adhering Sheet Membrane Waterproofing

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. C272, Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
    - b. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
    - c. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
    - d. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
    - e. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
    - f. D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
    - g. E96, Standard Test Methods for Water Vapor Transmission of Materials.
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. Building Materials Directory.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Manufacturer's recommendations on sealants, tapes and mastics.
- B. Informational Submittals:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Certification from insulation manufacturer stating that insulation proposed is acceptable for intended use per the Drawings.

##### **1.4 SITE CONDITIONS**

- A. For purposes of this Specification Section, design frost line for this Project is 30 IN below grade.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Rigid extruded polystyrene board insulation:
    - a. Dow.
    - b. Diversifoam Products.
    - c. Owens Corning.
  - 2. Blanket or batt thermal insulation:
    - a. Owens-Corning Fiberglass Corp.
    - b. United States Gypsum Company (USG).
    - c. CertainTeed.
  - 3. Vapor retarder:
    - a. Raven Industries.
    - b. Reef Industries.
    - c. Fortifiber Corp.
    - d. Alumiseal.
  - 4. Foamed plastic insulation:
    - a. Poly Master, Inc.
    - b. The Icynene Insulation System.
    - c. Insta-Foam Products.
- B. Submit request for substitution in accordance with Specification Section 00 72 13.

### **2.2 MATERIALS**

- A. General:
  - 1. Foam plastic insulation used in buildings and structures shall comply with the requirements of the Building Code.
    - a. Surface burning characteristics: ASTM E84.
    - b. Flame spread index: Maximum 75.
    - c. Smoke developed: Maximum 450.
- B. Rigid Polystyrene Board Insulation:
  - 1. Extruded: ASTM C578, Type IV.
    - a. Water vapor transmission: ASTM E96, 1.1 perm-IN maximum.
    - b. Water absorption: ASTM C272, 0.3 PCT maximum.
    - c. Thermal resistance: ASTM C518 at 75 DEGF mean temperature
  - 2. Provide insulation designed for intended use.
    - a. Perimeter insulation and protection board.
      - 1) Similar to Dow "Styrofoam PERIMATE."
      - 2) Compressive strength: ASTM D1621, 30 PSI.
      - 3) Thickness:
        - a) Perimeter insulation: As required to provide R-10 value.
        - b) Protection board: 1 IN.
      - 4) Edges:
        - a) Long edge: Shiplap.
        - b) Short edge: Square.
    - b. Cavity insulation:
      - 1) Similar to Dow "CAVITYMATE."
      - 2) Compressive strength: ASTM D1621, 15 PSI.
      - 3) Thickness: 2 IN. (Must meet R and U values called out on drawings.)
      - 4) Edges: Square.
- C. Sealant and Mastic (for setting polystyrene and/or polyisocyanurate insulation board): Manufacturer's recommended standard.

- D. Foamed Plastic Insulation:
  - 1. Two component powdered resin and aqueous foaming agent.
    - a. Formaldehyde free.
  - 2. Thermal conductivity (K-Factor): 0.216 (BTU/HR)/(SF)(DegF)/(IN), ASTM C518.
  - 3. Water vapor transmission: ASTM E96, maximum 6.631 perm IN.
- E. Blanket or Batt Thermal Insulation:
  - 1. Glass or other inorganic fibers and resinous binders formed into flexible blankets or semi-rigid sheets.
  - 2. Unfaced:
    - a. ASTM C665, Type 1.
  - 3. Minimum thickness as required to provide R-38 value.
- F. Vapor Retarder:
  - 1. Fire rated, reinforced, 3 ply, Class 1 material.
  - 2. Perm rating: Not exceeding 0.035 grains/HR-FT<sup>2</sup>-IN-Hg when determined in accordance with ASTM E96.
  - 3. Griffolyn "TX-1200FR."
- G. Vapor Retarder Tape: As recommended by vapor retarder manufacturer.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. General:
  - 1. Insulate full thickness over surfaces to be insulated.
  - 2. Fit tightly around obstructions, fill voids.
  - 3. Cover all penetrations (electrical junction boxes, switch boxes, piping, conduits, etc.) with insulation, taking care not to compromise the workings of the device.
  - 4. Fit butted joints of batt or blanket insulations tightly together.
  - 5. Apply single or double layer to achieve total thickness.
    - a. If double layer is provided, stagger all joints minimum 12 IN.
  - 6. Do not use broken or torn pieces of insulation.
  - 7. Install so that completed installation is vapor tight.
    - a. Seal all joints.
    - b. Seal to abutting materials to maintain vapor retarder integrity.
    - c. Provide manufacturer's recommended vapor retarder tape for use with faced batt insulation or separate vapor retarder.
      - 1) If vapor retarder tape fails to adhere to any surface, apply sprayed-on adhesive as recommended by tape manufacturer to promote adhesion.
    - d. Provide manufacturer's recommended solvent-free sealant compatible with insulation board for rigid board insulation.
      - 1) Tape is not acceptable for use with rigid board insulation.
- C. Blanket or Batt Insulation using Separate Vapor Retarder Sheet in Exterior Stud Wall Systems:
  - 1. Verify that all piping, conduit, electrical box and other in-wall work is complete prior to installing insulation and vapor retarder.
  - 2. Install insulation friction fit between studs.
  - 3. Tightly butt ends.
  - 4. Install vapor retarder to warm side of building exterior wall.
    - a. Completely seal each wall area to surrounding construction.
  - 5. Install vapor retarder vertically.
    - a. Use widest practical sheet.
    - b. Install in continuous sheets, floor to structure above, without horizontal joints.
    - c. Fold flaps of vapor retarder over studs.

- d. Tape flaps together continuously.
  - e. Tape bottom and top edges to structure continuously.
  - f. After installation of any additional conduit, boxes, piping or other items within wall system, repair all tears or penetrations of vapor retarder with vapor retarder tape prior to installation of gypsum board.
- D. Rigid Insulation at Perimeter Below Grade and Under Slab:
- 1. Install insulation below grade on outside face of foundation walls.
    - a. Install in mastic with tight joints.
  - 2. Where footings are located below the design frost line, extend insulation down to the design frost line.
    - a. Where indicated on the Drawings, extend beyond the design frost line.
  - 3. Where footings are located at the design frost line, extend insulation down to top of footing or as indicated on Drawings.
  - 4. Protect insulation from damage and/or displacement during backfilling and/or pouring of floor slab.

### **3.2 FIELD QUALITY CONTROL**

- A. Repair or replace damaged insulation and/or vapor retarder as directed by OWNER.

### **END OF SECTION**

**SECTION 07 26 00**  
**UNDER SLAB VAPOR RETARDER**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Under slab vapor retarder.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Concrete Institute (ACI):
    - a. 302.2R, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
  - 2. ASTM International (ASTM):
    - a. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
    - b. D1709, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
    - c. E96, Standard Test Methods for Water Vapor Transmission of Materials.
    - d. E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
    - e. E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Product data sheet on vapor retarder sheet and vapor retarder tape.
    - c. All accessories proposed for use.
    - d. Manufacturer's installation instructions.
  - 3. Certifications.
  - 4. Test reports.
- B. Samples:
  - 1. Provide two (2) 6 IN x 6 IN samples of vapor retarder material taped together using the vapor retarder tape proposed.
  - 2. Provide two (2) samples of all accessories proposed for use.
- C. Informational Submittals: Manufacturer's recommendation on vapor retarder tape.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Vapor retarder:
    - a. Fortifiber Corporation.

- b. Layfield Group
- c. Raven Industries.
- d. Reef Industries.
- e. Stego Industries.
- f. WR Meadows, Inc.

B. Submit request for substitution in accordance with Specification Section 00 72 13.

## **2.2 PERFORMANCE REQUIREMENTS**

- A. Vapor Retarder:
- 1. ASTM E1745, Class A.
  - 2. Thickness: Minimum 15 MIL.
  - 3. Water vapor permeance: 0.03 maximum per ASTM E96.
  - 4. Puncture resistance: ASTM D1709, Method B, 2200 grams.
  - 5. Minimum tensile strength: 45 LBS/IN, ASTM D882.

## **2.3 ACCESSORIES**

- A. Pipe Boots: Manufacturer's standard boot fabricated to maintain the integrity of the vapor retarder system.
- B. Vapor Retarder Tape: As recommended by vapor retarder manufacturers.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions, ASTM E1643 and ACI 302.2R.
- B. Provide vapor retarder where indicated on the Drawings.
- 1. Place continuous vapor retarder above granular fill subgrade material, unless noted otherwise.
- C. Lap minimum 6 IN and seal in accordance with ASTM E1643 and manufacturer's recommendations.
- D. Extend to extremities of area and seal to adjacent elements.
- E. Seal all penetrations: Provide pipe boot for all pipes or conduit penetrating the floor slab.

## **3.2 FIELD QUALITY CONTROL**

- A. Ensure proper precautions are implemented to prevent damage to installed vapor retarder membrane prior to and during pouring of concrete floor slab.
- B. Inspect vapor retarder immediately prior to placement of concrete.
- 1. Patch all punctures, tears, holes, etc.
    - a. Repair with additional layer of vapor retarder and seal entire patch with vapor retarder tape or as recommended by manufacturer.
    - b. Lap all repairs minimum 6 IN.

**END OF SECTION**

## **SECTION 07 61 13**

### **METAL ROOFING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Vapor retarder.
  - 2. Roof insulation.
  - 3. Ice dam membrane.
  - 4. Standing seam metal roofing.
  - 5. Soffit panels.
  - 6. Sheet metal work required for roofing.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 06 10 00 - Rough Carpentry.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Architectural Manufacturers Association (AAMA):
    - a. 621, Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.
    - b. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
  - 2. ASTM International (ASTM):
    - a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
    - b. A792, Standard Specification for Steel Sheet, 55 PCT Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
    - c. C209, Standard Test Methods for Cellulosic Fiber Insulating Board.
    - d. C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
    - e. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
    - f. D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
    - g. D4833, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
    - h. E96, Standard Test Methods for Water Vapor Transmission of Materials.
    - i. E1592, Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
    - j. E1646, Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
    - k. E1680, Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
    - l. E1745, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
    - m. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - 3. FM Global (FM):
    - a. 4450, Approval Standard for Class 1 Insulated Steel Deck Roofs.
    - b. 4471, Approval Standard for Class 1 Panel Roofs.

4. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
    - a. Architectural Sheet Metal Manual, Sixth Edition, 2003.
  5. Underwriters Laboratories, Inc. (UL):
    - a. Building Materials Directory.
    - b. Fire Resistance Directory.
    - c. 580, Standard for Tests for Uplift Resistance of Roof Assemblies.
    - d. 790, Standard Test Methods for Fire Tests of Roof Coverings.
    - e. 1256, Fire Test of Roof Deck Constructions.
  6. National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual for Metal Roofing, latest edition.
  7. Construction and Professional Services Manual (CPSM), including appendix A, current edition.
  8. Building code:
    - a. Virginia Construction Code 2015 Edition including all amendments, referred to herein as Building Code.
- B. Qualifications:
1. Manufacturer shall have minimum of 10 years experience in the production of structural standing seam metal roofing.
    - a. All structural components of the roof system shall be designed and sealed by registered professional structural engineer licensed in the State of Virginia.
  2. Installing contractor shall be licensed or approved in writing by manufacturer.
  3. Contractor and installer shall have minimum of seven (7) years experience in the installation of structural standing seam metal roof systems similar to system specified.
  4. Contractor and installer shall have successfully completed two (2) projects of similar size, scope and complexity within past two (2) years.
- C. Completed roof system to be inspected by roof manufacturer's authorized factory trained representative prior to issuance of roof warranty.

### 1.3 DEFINITIONS

- A. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  2. Installer and applicator are synonymous.
- B. Steep Slope: Having a pitch of 3:12 or greater.
- C. Low Slope: Having a pitch less than 3:12 but greater than 1/4:12.
- D. PVDF: Polyvinylidene fluoride.

### 1.4 SYSTEM DESCRIPTION

- A. Prefinished standing seam metal roof system, including but not limited to:
1. Ice dam membrane.
  2. Standing seam metal roof panels.
    - a. Roof panel shall be attached to roof deck using roof panel manufacturer's concealed clip anchors.
- B. All flashing and miscellaneous trim required for a complete water and airtight system, including but not limited to:
1. Flashing.
  2. Counterflashing.
  3. Roof edge trim.
  4. Sealants.
- C. Flat metal fascia system.
- D. Prefinished aluminum soffit panels.



## 1.5 SUBMITTALS

### A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Fabrication and/or layout drawings:
  - a. Manufacturer prepared computer generated Drawings showing anchorage, flashing, jointing and all other accessories required and all special detailing required by the system.
    - 1) Minimum plan scale: 1 IN = 8 FT.
    - 2) Minimum detail scale: 1-1/2 IN = 1 FT.
  - b. Provide complete erection plan for each building structure with all details and sections referenced, all penetrations shown, expansion joints shown, detailed and referenced, and all special conditions identified, referenced and detailed.
  - c. Erection plan to identify limits of each different substrate material (decking).
  - d. Provide distinction between factory and field assembled work.
3. Product technical data including:
  - a. Manufacturer data sheets on each component used in the roof system.
  - b. Acknowledgement that products submitted meet requirements of standards referenced.
    - 1) Certification by manufacturer that roofing assembly being supplied has been successfully tested under UL 580 procedures and has achieved a Class 90 rating.
    - 2) Certification of FM approval.
      - a) Provide FM test results.
4. Test results:
  - a. UL 580, Class 90 test data.
  - b. FM 4470, Class 1-90 test data.
  - c. ASTM E1592 test results.
    - 1) Provide results of tests conducted in accordance with ASTM E1592 for panel size and gage and clip type and spacing similar to panels and clips being used.
  - d. ASTM E1646 and ASTM E1680 test results.
  - e. Concentrated load test data.
    - 1) Load test to be conducted on panel size, gage and with clip spacing as required.
5. Qualifications:
  - a. Manufacturer: Provide structural engineer qualifications.
  - b. Contractor:
    - 1) Certification of approval or license to install product from manufacturer.
    - 2) Certification of experience.
    - 3) Listing of projects completed in the past two (2) years with similar scope.
    - 4) Completed projects information to include, square footage of roofing installed, dollar value of roofing installed, manufacturer and type of roofing installed and contact name and telephone number of building Owner.
  - c. Installer: Provide qualifications of all personnel expected to be working on the Project.
6. Roofing manufacturer's letter of approval for insulation proposed for use.
7. Warranty: Sample language of manufacturer's warranty to be provided on this Project.
8. Structural Engineer's sealed and signed calculations certifying that system structural components meet the requirements for lateral, upward and downward loads specified.

### B. Samples:

1. General: Tag, identify and provide statement regarding use for all fasteners, anchor clips, closures and sealants.
2. Roof panel:
  - a. Two (2) samples, full width, 24 IN long.
  - b. Provide color selected or specified when possible.
3. Fasteners.
4. Anchor clips.
5. Closures, (both metal and non-metallic).

6. Factory and field applied sealants.
7. Color samples:
  - a. For initial preliminary color selection, provide manufacturer's color chart showing all colors available.
  - b. For final color selection, provide two (2) 2 IN x 3 IN colored metal samples, for each color selected during the initial color selection.
- C. Contract Closeout Information:
  1. Operation and Maintenance Data:
    - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
  1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Final warranty.

## **1.6 WARRANTY**

- A. Provide 20 year complete system warranty, including material for air and weather tightness of entire roof assembly signed by manufacturer.
  1. Warranty limits shall meet the minimum load capacity requirements of ASTM E1592.
- B. Provide manufacturer's 20 year warranty on panel finish against fading, chipping, cracking and peeling of the panel exterior finish.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Metal roofing products specified are manufactured by Centria.
- B. Manufacturers listed and other manufacturers not listed, but capable of meeting this Specification Section, are expected to provide a system with similar profile, standing seam height, spacing, construction and factory applied finish.
- C. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Metal roofing:
    - a. Centria.
    - b. Merchant and Evans - Zip Rib.
    - c. IMETCO.
    - d. Other manufacturers capable of providing structural standing seam system and profiles similar to that specified will be considered.
  2. Ice dam membrane.
    - a. GAF Materials Corporation.
    - b. Carlisle Coatings & Waterproofing.
    - c. Owens Corning.
  3. PVDF resin:
    - a. PPG - DURANAR.
    - b. Valspar - Fluropon.
    - c. Arkema Inc. - KYNAR 500.
    - d. Solvay Solexis - HYLAR 5000.
    - e. Solvay Solexis - HYLAR 5000.
    - f. Soffit panels: Provided by metal roofing panel manufacturer.
- D. Submit request for substitution in accordance with Specification Section 00 72 13.

## 2.2 MATERIALS

- A. Roof Panels:
  - 1. General:
    - a. Galvalume steel, ASTM A792, Class SS, Grade 50B.
- B. Fascia Metal: 22 GA to match gutter material, finish and color.
- C. Soffit Panels: Aluminum, ASTM B209.
- D. Perimeter Trim, Panel Closures, Flashing and Counterflashing: Material and factory applied finish to match roof panels.
- E. Fasteners: 300 series stainless steel, ASTM F593.
- F. Intermediate Support System:
  - 1. Galvanized steel: ASTM A653, Class SS, Grade 50, G90.
- G. Sealant: Manufacturer's standard non-curing butyl.
- H. Ice dam membrane.
  - 1. Self-adhesive, polymer modified bituminous sheet.
  - 2. Thickness: Minimum 40 MIL.
  - 3. Manufactured to meet ASTM D1970.
  - 4. Non-slip surface.
  - 5. Acceptable to roofing manufacturer.

## 2.3 ACCESSORIES

- A. Roof Penetration Flashing:
  - 1. Round penetrations:
    - a. Premolded EPDM boot with metal collar.
    - b. Buildex "DEK-TITE."
- B. Flashing Curb:
  - 1. Provided by metal roofing manufacturer.
  - 2. One-piece completely seal welded prefabricated roof curb, including vertical flashing, and counter flashing, cricket on high side of penetration and flat pan fabricated to replace standing seam metal roof panel.
  - 3. Size as required for penetration.
  - 4. Bottom sloped to match roof.
    - a. Level on top.
  - 5. Minimum 16 GA galvanized steel.
    - a. Finish to match roof panel.
- C. Foam and metal closures, sealant, gaskets, fasteners, washers, clips, angles, and all miscellaneous trims shall be provided by roofing manufacturer, fabricated for the specific condition as required.
- D. Soffit Panels:
  - 1. Minimum 0.032 IN aluminum, ASTM B209.
  - 2. Factory applied finish to match roof panels.
  - 3. AAMA 2605.
  - 4. Profile: Flat interlocking sheet with reinforcing ribs as required to prevent warping and oil canning.
  - 5. Panel joints shall match standing seam spacing of roof panels when possible.
  - 6. Provide soffit vent panels where indicated on Drawings.
    - a. If not indicated, provide vent panels at maximum 4 FT OC with minimum of three (3) vent panels per side of building.
    - b. Vent panels shall be compatible with and supported by soffit panel systems.

- c. Vent panels shall have minimum 10 PCT free area and shall have the maximum amount of panel face perforations allowed structurally.
      - 1) Perforations to be in the form of holes, minimum 3/32 IN and maximum 1/8 IN DIA, equally spaced on staggered centers from row to row.
    - d. Vent panels shall be same size and profile as solid panels.
      - 1) Factory applied finish to match solid panels.
  - 7. Hat shaped steel channel sub-framing:
    - a. 1 IN deep x 20 GA steel.
    - b. Galvanized, ASTM A653, G90.
- E. Gutters and Downspouts:
  - 1. General:
    - a. Galvalume steel, ASTM A792/A792M, Class CS.
      - 1) Painted surfaces: AZ50.
      - 2) Unpainted surfaces: AZ55.
      - 3) Minimum thickness: 22 GA.
      - 4) All exposed surfaces to have finish and color to match roofing metal.
  - 2. Gutters:
    - a. "Style D" gutter per SMACNA Figure 1-2.
      - 1) Seamless except for expansion joints.
    - b. Gutter straps and eave closure flashing: Match gutter material, finish and color.
  - 3. Downspouts:
    - a. SMACNA Figure 1-32B.
      - 1) Seam on concealed side of downspout.
      - 2) Provide gutter to downspout connection per SMACNA Figure 1-33B, Detail 1.
    - b. Hanger Straps: Material and finish to match downspouts.
  - 4. Downspout locations as indicated on the drawings.

## 2.4 FABRICATION

- A. General:
  - 1. Fabricate with square, true corners, mitered and welded.
  - 2. Fabricate trim, flashings and closure pieces to match panel profile and finish.
  - 3. Hem all edges.
  - 4. Fabricate panels in full length with no end laps.
- B. Standing Seam Metal Roof Panels:
  - 1. Profile: Centria "SRS" System.
  - 2. Height of standing seam: 2IN.
  - 3. Gage: Minimum 24.
  - 4. Width:
    - a. 16IN.
    - b. Longitudinal stiffening elements to minimize oil canning.
  - 5. System shall be designed as a true standing seam shape.
  - 6. Finish:
    - a. PVDF based with minimum 70 PCT resin.
    - b. Three-coat system having minimum 0.8 MIL epoxy primer coat on both sides of panel with a 0.8 MIL PVDF resin color coat and a 0.8 MIL PVDF resin clear top coat on the exterior side of the panel.
    - c. Meet or exceed requirements of AAMA 621.
    - d. Smooth finish.
    - e. Color:
      - 1) To be selected from manufacturers full range of primary and secondary colors.
      - a) Does not include exotic, metallic flake or iridescent colors.
  - 7. Concealed fasteners:
    - a. Provide concealed fasteners in all locations.

- b. If exposed fasteners are required by the roof panel manufacturer, because of location, constructability issues or other critical design requirement, finish of fastener shall match roof panel finish.
      - 1) Exposed fasteners are to be approved by OWNER.
    - c. The use of deflection limiter devices is not allowed.
- C. Intermediate Support System:
  - 1. Roof panel anchor clips:
    - a. Manufacturer's standard one-piece clip suitable for condition.
      - 1) Two-piece clips are acceptable if required by roofing manufacturer.
    - b. Minimum 16 GA steel.
      - 1) Galvanized, ASTM A653, G90.
  - 2. Roof panel manufacturer shall be responsible for designing and providing all necessary intermediate "Z" or "hat-shaped" or other miscellaneous support members as required to transfer roof panel loads into building roof framing members.
    - a. Design in accordance with Building Code and loads shown on the Drawings.
  - 3. Bearing plates:
    - a. Sized by roofing manufacturer for roof loading indicated.
    - b. Minimum 16 GA steel.
      - 1) Galvanized, ASTM A653, G90.

## 2.5 SOURCE QUALITY CONTROL

- A. Roof assembly to be Class A roof covering assembly per UL 1256 and FM 4450.
- B. Structural Testing:
  - 1. The system shall be designed to safely resist the positive and negative loads per Building Code and as shown on Drawings.
  - 2. Structural-uniform uplift load capacity of the panel system shall be determined in accordance with ASTM E1592.
    - a. The factor of safety on the test results shall be 1.65 for the panel, batten or clip ultimate loads with no increase for wind.
    - b. The factor of safety for fasteners shall be 3.0 for one (1) single fastener per clip, 2.25 for two (2) fasteners per clip and 4.0 IN masonry.
    - c. Design uplift capacity for conditions of gage, span or loading other than those tested may be determined by interpolation of test results.
      - 1) Extrapolation of conditions outside the range of the tests is not acceptable.
    - d. Deflection shall be L/180 for positive loading.
- C. Water Penetration: No uncontrollable leakage at minimum 6.4 PS when tested in accordance with ASTM E1646.
- D. Air Infiltration: Maximum 0.036 scfm/SF when tested at 4.0 PSF differential pressure when tested in accordance with ASTM E1680.
- E. Fire Resistance/Wind Uplift Rating:
  - 1. UL 790, Class 1.
  - 2. UL 580, Class 90.
  - 3. FM 4471, 1-90. Verify requirements with OWNER.
- F. The panels shall withstand a 250 LB concentrated load applied to a 4 SQIN area at the center of the panel at mid span between supports with no panel deformation, rib buckling, or panel sidelap separation which will adversely affect the weather tightness of the system.
  - 1. Bearing plate and standing seam roof panel anchor clip attachment is to be determined by the roofing manufacturer and shall take precedent over this Specification.
    - a. Provide attachment to roof structural frame or deck as required for loading criteria specified.
  - 2. Roof panel anchor clips shall be designed to allow thermal movement of the panels except where specific fixed points are indicated.

- a. Roof panel manufacturer shall be responsible for determining fixed point locations unless otherwise indicated.
- 3. Wood blocking shown at roof edge is strictly for attachment of miscellaneous flashings and shall not be used for any structural value.
- 4. Maximum spacing of roof clips shall be determined by manufacturer.
- G. Roof panel manufacturer shall be responsible for designing and installing all necessary expansion joints in the roof system.
  - 1. Where roof expansion joints occur, provide corresponding expansion joints in fascia, soffit and gutters.

## **2.6 MAINTENANCE MATERIALS**

- A. Provide USER with 4 OZ of touch-up paint to match each different color used in the system.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General:
  - 1. Install products in accordance with manufacturer's instructions, SMACNA (where referenced) and details shown on Drawings for a complete weathertight installation without waves, warps buckles or distortions.
    - a. Provide all closures, trim, angles, plates, sealant, gaskets, fasteners, washers, etc., as necessary.
  - 2. Attachments shall allow for thermal expansion and contraction.
  - 3. Seal all joints as required for watertight installation.
  - 4. Touch-up paint all damaged surfaces.
- B. Ice Dam Membrane:
  - 1. Install per manufacturer's recommendations in areas indicated on Drawings.
  - 2. Provide ice dam membrane from eave line to a point that is a minimum of 36 IN horizontally inside the interior face of the exterior wall.
  - 3. Provide at all ridges, hip ridges and hip valley lines extending minimum 36 IN up the slope at valleys and down the roof slope each side of the ridge line.
- C. Standing Seam Roofing Panels:
  - 1. Install in one (1) continuous length from ridge to eave.
  - 2. Hand crimp battens at each clip.
  - 3. Seam panels and battens together with portable electric seaming machine supplied by the manufacturer.
- D. Soffit Panels:
  - 1. Install in accordance with manufacturer's recommendations using concealed fasteners when possible.
- E. Gutters:
  - 1. Install gutters using gutter straps in accordance with SMACNA Table 1-8 and Figure 1-12 and per roofing manufacturer's recommendations.
    - a. Provide gutter brackets or hangers at 24 IN OC maximum.
    - b. Provide expansion joints in gutters per SMACNA and at expansion joint locations shown on Drawings.
    - c. Install gutters to provide positive draining to downspout locations.
    - d. Seal all joints in gutters to provide completely water tight system.
- F. Downspouts:
  - 1. Install downspouts in locations shown on the Drawings.
  - 2. Provide downspout hanger straps per SMACNA Figure 1-35 as appropriate for downspout style.

3. Provide gutter to downspout connection per SMACNA Figure 1-33B, Detail 1.
4. Seal all joints in downspout for a complete watertight system.
  - a. Angle bottom of downspout out away from building.
5. Fasten hanger straps to building wall with stainless steel screws and anchor sleeves appropriate for wall construction.
  - a. Provide minimum of two fasteners per strap.
6. Maximum spacing of hanger straps shall be 10 FT with minimum of two hanger straps per vertical piece of downspout.
7. Spacing and location of hanger straps shall be consistent from downspout to downspout.

**END OF SECTION**

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**SECTION 07 62 00**  
**FLASHING AND SHEET METAL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Architectural flashing and sheet metal work.
  - 2. Factory formed fascia system(s).
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 04 05 23 - Masonry Accessories.
  - 4. Section 07 61 13 - Metal Roofing.
  - 5. Section 07 92 00 - Joint Sealants.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Architectural Manufacturers Association (AAMA):
    - a. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
  - 2. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
    - a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
  - 3. ASTM International (ASTM):
    - a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
    - b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
    - c. B32, Standard Specification for Solder Metal.
    - d. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - 4. FM Global (FM).
  - 5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
    - a. Architectural Sheet Metal Manual, Seventh Edition, 2012.
- B. Qualifications:
  - 1. Sheet metal fabricator shall have minimum 10 years experience in fabrication of sheet metal items similar to items specified.
  - 2. Sheet metal installer shall have minimum five (5) years experience installing sheet metal items specified.

**1.3 DEFINITIONS**

- A. Installer or Applicator:
  - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  - 2. Installer and applicator are synonymous.
- B. PVDF: Polyvinylidene fluoride.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  3. Fabrication and/or layout drawings.
    - a. Scaled drawing showing expansion joint locations, special conditions, profile, fastening and jointing details.
      - 1) Minimum plan scale: 1/8 IN = 1 FT.
      - 2) Minimum detail scale: 1-1/2 IN = 1 FT.
  4. Fabricator qualifications.
  5. Installer qualifications.
- B. Samples:
1. Finish and color samples for each product specified for USER preliminary color selection.
  2. For final color selection, provide two (2) 2 IN x 3 IN colored metal samples for each color selected during the preliminary color selection.
- C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Warranty: Manufacturer's sample warranty language.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pre-finished sheet metal:
    - a. Carlisle.
    - b. Firestone Building Products.
    - c. Petersen Aluminum Corp.
  2. Factory-formed fascia system.
    - a. W.P. Hickman Co.
    - b. Metal Era, Inc.
  3. Butyl sealant:
    - a. Pecora.
    - b. Sika.
    - c. Tremco.
- B. Submit request for substitution in accordance with Specification Section 00 72 13.

### **2.2 MATERIALS**

- A. Sheet Metal:
1. Aluminum: ASTM B209.
  2. Galvanized Steel: ASTM A653.
  3. Stainless Steel: ASTM A666.
    - a. Type 316
- B. Fasteners: Non-ferrous compatible with sheet metal.
- C. Sealants:
1. Non-curing Butyl Sealant:
    - a. Pecora "BA-98 IN.
    - b. Sika "SikaLastomer 511 IN.
    - c. Tremco "TremPro JS-773 IN.
  2. Building sealants:
    - a. See Specification Section 07 92 00.

- D. Fasteners: Non-ferrous compatible with sheet metal.
- E. Retainer Clips and Continuous Cleats: Galvanized steel or stainless steel.
- F. Solder: ASTM B32.
- G. Dissimilar Metal Protection: Comply with Specification Section 09 96 00.

## **2.3 MANUFACTURED ITEMS**

- 1. Fascia cover:
    - a. Aluminum.
      - 1) Thickness: 0.040
    - b. Galvanized steel, ASTM A653, G-60.
      - 1) Thickness: 22 GA.
  - 2. Factory fabricated accessories, including but not limited to:
    - a. Corners, end caps, end terminations.
    - b. All accessories to be factory mitered and welded.
    - c. Height: As indicated on drawings
- B. Finish:
- 1. PVDF coating with minimum 70 PCT resin content.
    - a. Meet requirements of AAMA 2605.
      - 1) Color: As selected by USER.

## **2.4 FABRICATED ITEMS**

- A. General:
- 1. Shop fabricate items to maximum extent possible.
    - a. Fabricate true and sharp to profiles and sizes indicated on Drawings.
      - 1) Shop fabricate and weld or solder all corners.
  - 2. Pre-finished aluminum:
    - a. Thickness: Minimum 0.040
    - b. Texture: Smooth
    - c. Coated on exposed face with PVDF coating having a minimum 70 PCT resin content and a minimum 1.0 MIL dry film thickness.
      - 1) Meet requirements of AAMA 2605.
      - 2) Color: Match wall panels and fascia.
  - 3. Pre-finished steel:
    - a. Galvanized, G-60 or Galvalume, AZ-55.
    - b. Thickness: Minimum 24 GA.
    - c. Texture: Smooth.
    - d. Coated on exposed face with PVDF coating having a minimum 70 PCT resin content and a minimum 1.0 MIL dry film thickness.
      - 1) Meet requirements of AAMA 2605.
      - 2) Color: From Manufacturer's available standard colors.
  - 4. Stainless steel:
    - a. Thickness: Minimum 0.050 IN.
    - b. Texture: Smooth.
- B. Retainer Clips and Continuous Cleats:
- 1. 0.050 IN stainless steel.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Provide items to be built into other construction to Contractor in time to allow their installation.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions, SMACNA, and as indicated on Drawings.
- B. Weld aluminum to achieve weathertight joints and required details.
  - 1. Do not weld slip joints.
  - 2. Touch-up damaged prefinished items.
- C. Set top edges of membrane flashing and sheet metal flashing into reglets wherever practicable.
  - 1. Surface applied terminations will be allowed only where specifically detailed or otherwise approved in writing by the OWNER.
  - 2. Seal reglets and counterflashings in accordance with Specification Section 07 92 00.
- D. Fasten materials at intervals recommended by SMACNA.
- E. Install slip joints to allow for thermal movement as recommended by SMACNA and manufacturer.
  - 1. Maximum spacing: 10 FT OC.
  - 2. Provide slip joint 24 IN from corners.
  - 3. Provide slip joint at each vertical expansion joint location in wall.
    - a. Provide break in continuous cleat at each vertical expansion joint.
    - b. The above expansion joints do not include brick veneer expansion joints.
- F. Seal slip joints with two (2) beads of non-curing butyl sealant on each side of slip joint overlap.
- G. Form flashings to provide spring action with exposed edges hemmed or folded to create tight junctures.
- H. Provide dissimilar metals and materials protection where dissimilar metals come in contact or where sheet metal contacts mortar, concrete masonry or concrete.
- I. Provide all miscellaneous sheet metal items not specifically covered elsewhere, as indicated or required to provide a weathertight installation.
  - 1. Provide all components necessary to create weather-tight junctures between roofing and sheet metal work.

### **END OF SECTION**

## **SECTION 07 92 00**

### **JOINT SEALANTS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Sealing all joints which will permit penetration of dust, air or moisture.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Concrete Institute (ACI):
    - a. 302.1R, Guide for Concrete Floor and Slab Construction.
  - 2. ASTM International (ASTM):
    - a. C834, Standard Specification for Latex Sealants.
    - b. C920, Standard Specification for Elastomeric Joint Sealants.
    - c. C1521, Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
  - 3. NSF International (NSF):
    - a. 61, Drinking Water System Components -- Health Effects.
  - 4. Underwriters Laboratories, Inc. (UL).
- B. Qualifications: Sealant applicator shall have minimum five (5) years experience using products specified on projects with similar scope.

##### **1.3 DEFINITIONS**

- A. Corrosive Areas Include: Incubation Room
- B. Defect(ive): Failure of watertightness or airtightness.
- C. Finish sealant: Sealant material per this specification applied over face of compressible sealant or expanding foam sealant specified, to provide a finished, colored sealant joint.
- D. Installer or Applicator:
  - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  - 2. Installer and applicator are synonymous.
- E. "Interior wet areas": laboratories, and similar areas.
- F. "Seal," "sealing" and "sealant": Joint sealant work.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Manufacturer's recommendations for joint cleaner, primer, backer rod, tooling and bond breaker.

3. Certification from sealant manufacturer stating product being used is recommended for and is best suited for joint and / or application in which it is being applied.
  4. Certification of applicator qualification.
- B. Test Results:
1. Provide adhesion test results for each sealant sample including adhesion results compared to adhesion requirements.
  2. Manufacturer's authorized factory representative recommended remedial measures for all failing tests.
- C. Samples:
1. Cured sample of each color for USER's color selection.
  2. Color chart not acceptable.
- D. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver material in manufacturer's original unopened containers with labels intact: Labels shall indicate contents and expiration date on material.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Compressible sealant:
    - a. Polytite Manufacturing Corporation.
    - b. Emseal.
    - c. Norton.
    - d. Sandell.
  2. Expanding foam sealant:
    - a. Macklanburg Duncan.
    - b. Convenience Products.
    - c. FAI International, Inc.
  3. Polyether sealants:
    - a. BASF.
    - b. ChemLink, Inc.
    - c. Tremco.
  4. Polysulfide rubber sealant:
    - a. Pecora.
    - b. BASF.
    - c. PolySpec.
  5. Polyurea joint filler:
    - a. Dayton Superior Specialty Chemical Corporation.
    - b. Euclid Chemical Co.
    - c. L&M Construction Chemicals, Inc.
    - d. BASF.
  6. Polyurethane sealants:
    - a. Pecora.
    - b. Sika Chemical Corp.
    - c. BASF.
    - d. Tremco.
  7. Silicone sealants:
    - a. ChemLink.

- b. GE Construction Sealants.
- c. Dow Corning.
- d. Tremco.
- 8. Backer rod, compressible filler, primer, joint cleaners, bond breaker: As recommended by sealant manufacturer.

B. Submit request for substitution in accordance with Specification Section 00 72 13.

## 2.2 MATERIALS

### A. Sealants - General:

- 1. Provide colors matching materials being sealed.
- 2. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.
- 3. Nonsagging sealant for vertical and overhead horizontal joints.
- 4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
- 5. Joint cleaner, primer, bond breaker: As recommended by sealant manufacturer.
- 6. Sealant backer rod and/or compressible filler:
  - a. Closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, nonabsorbent, non-bituminous material recommended by sealant manufacturer to:
    - 1) Control joint depth.
    - 2) Break bond of sealant at bottom of joint.
    - 3) Provide proper shape of sealant bead.
    - 4) Serve as expansion joint filler.

### B. Compressible Sealant:

- 1. Foamed polyurethane strip saturated with polymerized polybutylene waterproofing coated on front face with nonreactive release agent that will act as bond breaker for applied sealant.
  - a. Polytite Manufacturing Corp. "Polytite-B."
- 2. Fire rated where required.
- 3. Adhesive: As recommended by sealant manufacturer.

### C. Expanding Foam Sealant:

- 1. One (1) or two (2) component fire rated moisture cured expanding urethane.
- 2. Shall not contain formaldehyde.
- 3. Density: Minimum 1.5 PCF.
- 4. Closed cell content: Minimum 70 PCT.
- 5. R-value: Minimum 5.0/IN.
- 6. Flame spread: Less than 25.
- 7. Smoke developed: Less than 25.

### D. Polyether Sealant:

- 1. Silyl-terminated polyether polymer.
- 2. ASTM C920, Type S, Grade NS, Class 50, Use NT, M, A, and O.
  - a. BASF MasterSeal 150.
  - b. ChemLink DuraLink.
  - c. Tremco Dymonic FC

### E. Polysulfide Rubber Sealant:

- 1. One (1) or two (2) component.
- 2. Meet ASTM C920.
  - a. Pecora Synthacalk GC2+.
  - b. PolySpec THIOKOL 2235.

### F. Polyurea Joint Filler:

- 1. Two (2) component, semi-rigid material for filling formed or saw-cut control joints in interior concrete slabs.
  - a. Dayton Superior Specialty Chemical Corp. "Joint Fill, Joint Seal, Joint Saver II" as required for condition and recommended by manufacturer.

- b. Euclid Chemical Co. "EUCO QWIK" joint.
    - c. L&M Construction Chemicals, Inc. "Joint Tite 750 IN.
    - d. BASF MasterSeal "CR100 IN control joint filler.
  - 2. Comply with ACI 302.1R performance recommendations regarding control and construction joints.
  - 3. Color: Gray.
- G. Polyurethane Sealant:
- 1. One (1) or two (2) components.
  - 2. Paintable.
  - 3. Meet ASTM C920 Type S or Type M, Grade NS or P, Class 25, Use NT, T, M, A and O.
    - a. Pecora Dynatrol-IXL, Dynatrol II, Urexpan NR-200, NR-201.
    - b. Sika Chemical Corporation Sikaflex-1a, Sikaflex-2C NS/SL.
    - c. BASF MasterSeal NP-1, NP-II, SL-1 SL-2.
    - d. Tremco Dymonic or Dymeric, Vulkem 116,227,45,245.
- H. Silicone Sealant:
- 1. One (1) component.
  - 2. Meet ASTM C920, Type S, Grade NS, Class 25, Use NT, G, A, O.
    - a. ChemLink: DuraSil.
    - b. General Electric: Silpruf, Silglaze II.
    - c. General Electric: Sanitary 1700 sealant for sealing around plumbing fixtures.
    - d. Dow Corning: 786 for sealing around plumbing fixtures.
    - e. Dow Corning: 7565, 790, 791, 795.
    - f. Tremco: Spectrem 1, Spectrem 3, Tremsil 600.
  - 3. Mildew resistant for sealing around plumbing fixtures.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Before use of any sealant, investigate its compatibility with joint surfaces, fillers and other materials in joint system.
- B. Use only compatible materials.
- C. Where required by manufacturer, prime joint surfaces.
  - 1. Limit application to surfaces to receive sealant.
  - 2. Mask off adjacent surfaces.
- D. Provide joint depth for joints receiving polyurea joint filler in accordance with manufacturer's recommendations.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions and UL requirements.
- B. Clean all joints.
- C. Make all joints water and airtight.
- D. At changes in direction of joints, joint intersections and where sealant joints interface with other construction, install continuous sealant as necessary to ensure a weather-tight seal.
- E. Make depth of sealing compounds, except expanding foam and polyurea sealant, not more than one-half width of joint, but in no case less than 1/4 IN nor more than 1/2 IN unless recommended otherwise by the manufacturer.
- F. Provide correctly sized backer rod, compressible filler or compressible sealant in all joints to depth recommended by manufacturer:
  - 1. Take care to not puncture backer rod and compressible filler.



2. Provide joint backer rod as recommended by the manufacturer for polyurea joint filler.
- G. Apply bond breaker where required.
- H. Tool sealants using sufficient pressure to fill all voids.
- I. Upon completion, leave sealant with smooth, even, neat finish.
- J. Where piping, conduit, ductwork, etc., penetrate wall, seal each side of wall opening.
- K. Install compressible sealant to position at indicated depth.
  1. Size so that width of material is twice joint width.
  2. Take care to avoid contamination of sides of joint.
  3. Protect side walls of joint (to depth of finish sealant).
  4. Install with adhesive faces in contact with joint sides.
  5. Install finish sealant where indicated.
- L. Install expanding foam sealant to minimum 4 IN depth or thickness of wall being penetrated if less than 4 IN or as indicated on Drawings.
  1. Provide adequate fire rated backing material as required.
  2. Hold material back from exposed face of wall as necessary to allow for installation of backer rod and finish sealant.
    - a. Allow expanding foam sealant to completely cure prior to installing backer rod and finish sealant.
  3. Trim off excess material flush with surface of the wall if not providing finished sealant.
  4. Prior to using expanding foam sealant in openings occurring in the veneer wythe of cavity wall construction, install backer rod to a depth that will provide sufficient foam sealant depth, per the manufacturer, and will also prevent the foam from expanding into and filling the cavity.

### **3.3 SEALANT WORK**

- A. General:
  1. Work includes but is not limited to: Sealing all joints which will permit penetration of dust, air, or moisture.
  2. Refer to SCHEDULE for materials to be used.
- B. Concrete joints:
  1. Flooring joints.
  2. Isolation joints.
  3. Joints between paving or sidewalks and building.
  4. Construction, control and expansion joints.
  - 5.
- C. Masonry:
  1. Masonry control joints.
  2. Between masonry and other materials.
- D. Flashing, reglets and retainers.
- E. Openings:
  1. Perimeters of door and window frames, louvers, grilles, etc.
  2. Door thresholds shall be set in a full bed of sealant.
- F. Plumbing fixtures.
- G. Penetrations of walls and floors.
- H. Other joints where sealant, expanding foam sealant or compressible sealant is indicated.

### **3.4 FIELD QUALITY CONTROL**

- A. Adhesion Testing:

1. Perform adhesion tests in accordance with ASTM C1521 per the following criteria:
  - a. Water bearing structures: One (1) test per every 1000 LF of joint sealed.
  - b. Chemical containment areas: One (1) test per every 1000 LF of joint sealed.
  - c. Building expansion joints: One (1) test per every 500 LF of joint sealed.
  - d. All other type of joints except butt glazing joints: One (1) test per every 3000 LF of joint sealed.
  - e. Manufacturer's authorized factory representative shall recommend, in writing, remedial measures for all failing tests.

### 3.5 SCHEDULE

- A. Furnish sealant as indicated for the following areas:
  1. Exterior areas:
    - a. Above grade: Polyurethane
    - b. Below grade: Polyurethane.
  2. Interior areas:
    - a. Noncorrosive areas:
      - 1) Wet exposure: Silicone
        - a) Toilet rooms, locker rooms, janitor closets or similar areas: Mildew resistant silicone.
      - 2) Dry exposure: Silicone, unless noted otherwise.
    - b. Corrosive areas:
      - 1) Wet exposure: Polyurethane.
      - 2) Dry exposure: Silicone.
    - c. Sealant exposed to or having the potential of being exposed to concentrated chlorine gas or chlorine liquid: Polysulfide.
    - d. Casework, countertops and solid surface materials: Silicone.
      - 1) Sinks, fixtures or other areas subject to potential splash, spillage or condensation: Mildew Resistant Silicone.
  3. Immersion:
    - a. Prolonged contact with or immersion in:
      - 1) Potable water:
        - a) Polysulfide.
        - b) NSF 61 approved.
      - 2) Nonpotable water, wastewater or sewage: Polysulfide.
  4. Compressible sealant: Where indicated.
  5. Exterior wall penetrations: Expanding urethane foam, with finish sealant.
    - a. Finish sealant:
      - 1) Exterior side:
        - a) Above grade: Polyether.
        - b) Below grade: Polyurethane.
      - 2) Interior side:
        - a) Noncorrosive area:
          - (1) Wet exposure: Silicone
          - (2) Dry exposure: Silicone, unless noted otherwise.
        - b) Corrosive area:
          - (1) Wet exposure: Polyurethane.
          - (2) Dry exposure: Polyurethane
  6. Interior concrete slab formed or saw-cut control joints: Polyurea joint filler.

### END OF SECTION



DIVISION 08

OPENINGS



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**SECTION 08 11 00**  
**HOLLOW METAL DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Metal doors and frames.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 08 70 00 - Finish Hardware.
  - 2. Section 09 96 00 - High Performance Industrial Coatings.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 2. National Association of Architectural Metal Manufacturers (NAAMM):
    - a. Hollow Metal Manufacturers Association (HMMA).
  - 3. Steel Door Institute (SDI):
    - a. 117, Manufacturing Tolerances for Standard Steel Doors and Frames.
    - b. All SDI publications.
  - 4. Steel Door Institute/American National Standards Institute (SDI/ANSI):
    - a. A250.6, Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
    - b. A250.7, Nomenclature for Standard Steel Doors and Steel Frames.
    - c. A250.8, Specifications for Standard Steel Doors and Frames.
    - d. A250.10, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
    - e. A250.11, Recommended Erection Instructions for Steel Frames.
- B. Qualifications: Manufacturer must be current member of SDI, and NAAMM (HMMA).
- C. Wipe coat galvanized steel is not acceptable as substitute for galvanizing finish specified.

**1.3 DEFINITIONS**

- A. As identified in SDI/ANSI A250.7.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  - 2. Schedule of doors and frames using same reference numbers as used on Drawings.
  - 3. SDI certification.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store doors and frames in accordance with SDI/ANSI A250.11.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Metal doors and frames:
    - a. Ceco Door by ASSA ABLOY.
    - b. Steelcraft by Allegion PLC.
    - c. Curries by ASSA ABLOY.

### **2.2 MATERIALS**

- A. Steel Sheet: Hot-dipped galvanized steel, ASTM A653, A60 coating.
- B. Frames: Hot-dipped galvanized steel, ASTM A653, A60 coating.
- C. Supports and Reinforcing: Hot-dipped galvanized steel, ASTM A653, A60 coating.
- D. Inserts, Bolts and Fasteners: Manufacturer's standard.
- E. Primer: Manufacturer's standard coating meeting SDI/ANSI A250.10.
- F. Galvanized Coating Repair: See Specification Section 09 96 00.
- G. Thermal Insulation: Polyurethane, CFC free.
- H. Sound Insulation: Fiberglass batt insulation or impregnated Kraft honeycomb.

### **2.3 ACCESSORIES**

- A. Frame Anchors:
  - 1. Jamb anchors:
    - a. Masonry wire anchors: Minimum 0.1875 inches wire, galvanized.
    - b. Stud partition and base anchors: Minimum 18 GA, galvanized.

### **2.4 FABRICATION**

- A. General:
  - 1. SDI/ANSI A250.8.
  - 2. Fabricate rigid, neat in appearance and free from defects.
  - 3. Form to sizes and profiles indicated on Drawings.
    - a. Beveled edge.
  - 4. Fit and assemble in shop wherever practical.
  - 5. Mark work that cannot be fully assembled in shop to assure proper assembly at site.
  - 6. Continuously wire weld all joints, dress exposed joints smooth and flush.
  - 7. Fabricate doors and frames to tolerance requirements of SDI 117.
  - 8. Fit doors to SDI clearances.
  - 9. All doors shall be handed.
  - 10. Hinge cut-out depth and size on doors and frames shall match hinge specified in Specification Section 08 70 00.
  - 11. Design and fabricate doors to requirements of the building code.
- B. Hollow Metal Doors:
  - 1. General:
    - a. 1-3/4 inches thick.
    - b. Fabricate with flush top caps.
      - 1) Thickness and material to match door face.
      - 2) Exterior doors: Seal weld top cap to door face and grind smooth and flush.
    - c. Continuously wire weld all joints and dress, smooth and flush.
  - 2. Exterior:
    - a. Doors 48 inches wide, or less: SDI/ANSI A250.8, Level 3, and physical performance level A, Model 2.

- 1) Face sheet minimum thickness: 16 GA.
  - 2) Insulated: Minimum R10.
- b. Sound insulated, minimum STC-35.
- C. Hollow Metal Frames:
  - 1. Door frames:
    - a. Provide 2 inches face at all heads, jambs and mullions for frames in stud walls.
    - b. Provide 4 inches face at head where noted on Drawings or required by wall construction.
    - c. 26 GA galvanized steel boxes welded to frame at back of all hardware cutouts.
    - d. Steel plate reinforcement welded to frame for hinge, strikes, closers and surface-mounted hardware reinforcing.
      - 1) All plate reinforcement shall meet size and thickness requirements of SDI/ANSI A250.8.
    - e. Split type frames not acceptable.
      - 1) All horizontal and vertical mullions and transom bars shall be welded to adjacent members.
    - f. Conceal all fasteners.
    - g. Frames shall be set up, all face joints continuously wire welded and dressed smooth.
    - h. Exterior (up to 4 feet wide): 16 GA.
    - i. Provide removable spreaders at bottom of frame.
- D. Prepare for finish hardware in accordance with hardware schedule, templates provided by hardware supplier, and SDI/ANSI A250.6.
  - 1. Locate finish hardware in accordance with SDI/ANSI A250.8.
  - 2. See Specification Section 08 70 00 for hardware.
  - 3. Prepare doors for swing direction indicated.
    - a. Preparing doors for non-handed hinges is not acceptable.
- E. After fabrication, clean off mill scale and foreign materials and prime with rust inhibiting primer.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install doors and frames in accordance with SDI/ANSI A250.11, the building code and manufacturer's instructions.
- B. Plumb, align, and brace frames securely until permanently anchored.
  - 1. After completion of walls, remove temporary braces and spreaders.
  - 2. Anchor frames with minimum of three anchors per jamb.
    - a. Number and location of anchors shall be in accordance with SDI and frame manufacturer's recommendations.
- C. At metal stud construction, place frames in conjunction with construction of walls or partitions.
  - 1. Metal stud construction:
    - a. Anchor frames using steel stud anchors.
    - b. Attach wall anchors with self-tapping screws.
- D. Use plastic plugs to keep silencer holes clear during construction.
- E. Immediately after erection, sand smooth rusted or damaged areas.
  - 1. Touch-up with rust-inhibiting primer.
  - 2. Finish paint door and frame in accordance with Specification Section 09 96 00.
- F. Install three silencers on strike jamb of single door frame and two on head of double door frame.
  - 1. See Specification Section 08 70 00.
- G. Protect doors and frames during construction.

**END OF SECTION**



## **SECTION 08 51 13**

### **ALUMINUM WINDOWS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Aluminum windows.
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 07 92 00 - Joint Sealants.
  - 2. Section 08 81 00 - Glass and Glazing.
  - 3. Section 09 96 00 - High Performance Industrial Coatings.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Architectural Manufacturers Association (AAMA):
    - a. 904, Voluntary Specification for Multi-Bar Hinges in Window Applications
    - b. 1503, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
    - c. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
  - 2. ASTM International (ASTM):
    - a. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
    - b. C1363, Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
    - c. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
    - d. E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference.
    - e. E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
  - 3. American Welding Society (AWS):
    - a. D1.2, Structural Welding Code - Aluminum.

##### **1.3 DEFINITIONS**

- A. Installer or Applicator:
  - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  - 2. Installer and applicator are synonymous.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data for framing system and major accessories including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Hardware being provided by window manufacturer.
    - c. Glass being provided by window manufacturer in factory glazed units.
    - d. Manufacturer's installation instructions.
  - 2. Elevation drawings indicating window dimensions and details.
- B. Samples:

1. After initial color selection, provide 2 x 3 inches minimum sample of each color and finish selected.
- C. Informational Submittals:
  1. Qualifications of testing laboratory.
  2. Test results.
  3. Warranty.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store units in vertical position off ground with wood spacers between each unit.

## **1.6 WARRANTY**

- A. Five year warranty of weathertightness of installation.
  1. Air and water integrity and structural adequacy of units and hardware, including sealants and sealing within and around perimeter of installation.
  2. Signed jointly by fabricator, installer, and contractor.

# **PART 2 - PRODUCTS**

## **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Thermally broken windows:
    - a. Wausau Metals Corp., 2250-T Series.
    - b. Kawneer Company Inc., 8225-T Series.
    - c. EFCO Windows, Series [510] [520] [530] [540].

## **2.2 MATERIALS**

- A. Extruded Aluminum: 6063T5 alloy.
- B. Sealants: As specified in Section 07 92 00.
- C. Thermal Insulator: Poured in place polyurethane, self-adhering to adjacent aluminum surfaces.
- D. Weatherstripping: Sponge neoprene.

## **2.3 ACCESSORIES**

- A. Screens:
  1. 18 x 16 mesh aluminum wire screens.
  2. Secure to aluminum shapes with vinyl spline.
  3. Hold in place with spring loaded plungers.
  4. Removable to inside of building.
  5. Finish same as window frames.
- B. Flashing:
  1. Minimum 0.040 inches aluminum.
  2. Finish to match window frames.
  3. Mill finish if concealed.

## **2.4 FABRICATION**

- A. General:
  1. Fully degrease and clean members prior to assembly or application of protective coatings.
  2. Weld by methods recommended by manufacturer and AWS D1.2 to avoid discoloration at welds.
  3. Grind exposed welds smooth and restore finish.
  4. Ease corners of cut edges to a radius of approximately 1/64 inches.

5. Conceal fasteners wherever possible.
  6. Fit and assemble work at shop to maximum extent possible.
  7. Maintain true continuity of line and accurate relation of planes and angles.
  8. Provide secure attachment and support at mechanical joint, with hairline fit of contacting members.
  9. Reinforce work as necessary to withstand wind loadings and to support system.
  10. Separate dissimilar metal with paint or preformed separators to prevent corrosion.
    - a. See Section 09 96 00.
  11. Separate metal surfaces at moving joints with plastic inserts or other nonabrasive concealed inserts to permanently prevent freeze-up of joint.
  12. Reinforce frames for hardware.
  13. Structural steel reinforcement hot-dip galvanized after fabrication meeting G-90, ASTM A924, requirements.
- B. Thermal Insulator: Provide minimum 1/4 inches separation between exterior and interior metal surfaces after bridge is removed.
- C. Weatherstripping:
1. Thermally broken type windows:
    - a. Casement and projected:
      - 1) Provide two rows of fin type extruded neoprene weatherstrips extending around perimeter of sash at both inner and outer overlap contacts.
      - 2) Provide corners which are securely staked and joined.
      - 3) Provide units which are easily replaceable.
- D. Window Hardware:
1. General:
    - a. Locking device and strikes: White bronze and/or non-magnetic stainless steel.
    - b. All hardware elements that bridge sash or frame thermal barrier: Reinforced nylon, deirin or suitable non-metallic, low conductivity material.
    - c. Custodial key operation: Secure sash in closed position and automatically lock in washing position.
    - d. Safety keys removable only in closed position.
  2. Glass: See Section 08 81 00 for types of glass to be installed under this Section.
- E. Fasteners:
1. Finish exposed fasteners to match finish of system.
  2. Provide Phillips flat head screws where exposed.
- F. Finish: AAMA 2605 Fluoropolymer paint; color to be [\_\_\_\_\_] [AA-MA10C22A31+, clear anodized] [AA-MA10C22A42, anodized].
1. Color: [Dark bronze] [Medium bronze] [Light bronze] [Black].

## 2.5 SOURCE QUALITY CONTROL

- A. General Test Requirements:
1. Utilize independent testing laboratories specifically qualified to conduct all performance tests required.
  2. Performance tests may be conducted in manufacturer's laboratories provided they are witnessed and certified by qualified independent testing laboratory personnel.
  3. Perform all tests on "Test Unit":
    - a. Full-sized window unit for project or a minimum 5 x 8 feet unit mounted in test chamber in exact accordance with job conditions including anchorage system, sealing, etc.
    - b. Test unit to be completely assembled and glazed.
      - 1) Thermal tests may be conducted on 4 x 6 feet unit.
  4. Test air infiltration first, water resistance second.
    - a. Other tests may be in any order.

5. Test data on vertical pivot windows will be accepted for fixed windows for condensation resistance, thermal, temperature exposure and acoustical tests provided the fixed windows are the same as the vertical windows tested in the following respects:
    - a. Same frame section (or same family of extrusions).
    - b. Same basic metal mass inside and outside.
    - c. Identical thermal break.
    - d. Same type of glazing.
- B. Test Requirements:
1. Air infiltration test:
    - a. With sash and ventilators closed and locked, test in accordance with ASTM E283.
    - b. Air infiltration, in CFM/FT of crack length, at pressure differential of 6.24 psf as follows:
      - 1) Fixed windows: 0.06 maximum, all others 0.10 maximum.
  2. Water resistance test:
    - a. Mount glazed unit in its vertical position, continuously supported around outside perimeter with sash and ventilators closed and locked.
    - b. Test in accordance with ASTM E331.
    - c. No uncontrolled leakage allowed, with pressure differential of 6.24 psf.
  3. Uniform load deflection test:
    - a. Test in accordance with ASTM E330.
    - b. Subject unit to load of 25 psf applied to outside of window and 25 psf applied to inside of window.
    - c. Maximum allowable deflection of any unsupported span:  $L/175$ .
    - d. No glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms, or any other damage which would cause window to be inoperable will be allowed.
  4. Uniform load structural test:
    - a. Test in accord with ASTM E330.
    - b. Subject unit to loads indicated below.
    - c. Stabilize pressure and maintain it for minimum period of 10 seconds.
    - d. No glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms or any other damage which would cause window to be inoperable will be allowed.
    - e. Maximum permanent deformation of any main frame, sash or ventilator member: 0.4% of its span.
    - f. After performing Uniform Load Structural Test, increase loads 1-1/2 times and perform safety test.
    - g. Design unit to withstand following design pressures acting normal to plane of wall, at applicable heights and locations.
      - 1) At height of 30 feet or less: [ ] PSF acting inward [ ] PSF acting outward.
  5. Condensation resistance test:
    - a. Perform on "test unit," except size may be 3 x 4 feet, minimum.
    - b. Test in accordance with AAMA 1503.
    - c. CRF (Condensation Resistance Factor): 50, minimum.
  6. Thermal test:
    - a. Perform on "test unit" except size may be 4 x 6 feet, minimum.
    - b. Test in guarded hot box ASTM C1363, with an exterior temperature of 18 degrees F, an interior of 68 degrees F and 15 mph fan-generated wind velocity on exterior.
    - c. "U" value: not to exceed 0.65 btu/HR/SQFT/DEGF.
    - d. Calculated "U" values from smaller units or data or theoretical assumptions will not be acceptable.
  7. Temperature exposure test:
    - a. Perform on "test unit" except size may be 4 x 6 feet, minimum.

- b. Maintain interior chamber temperature at 70 degrees F.
- c. Reduce exterior ambient temperature to minus 15 degrees F.
- d. Interior rail of frame and ventilator must maintain a temperature of not less than +[\_\_\_\_\_] DEGF as indicated by thermocouple temperature sensing.
- 8. Structural thermal barrier tension test:
  - a. Test urethane filled sections of aluminum.
  - b. Mechanically secure interior and exterior faces of 12 inches section in horizontal position.
  - c. Apply heat tape to exterior face to control surface temperature at 180 degrees F 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
  - d. Apply direct tension (pull) using a Universal testing machine set in 12,000 pound load range.
  - e. Test results: No loss of bond at 4000 pound IN/IN/MIN.
- 9. Structural thermal barrier shear test:
  - a. Test urethane filled sections of aluminum.
  - b. Mechanically secure interior face of 12 inches section in vertical position.
  - c. Apply heat tape to exterior face to control surface temperature at 180 degrees F 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
  - d. Apply load to exterior face by a bearing plate resting on top of exterior face, using Universal Testing machine set in 12,000 pound load range at a strain rate of 0.050 inches/IN/MIN.
  - e. Test results: No loss of bond at 5500 pound loading.
- 10. Structural thermal barrier combined torsion and shear test:
  - a. Test urethane filled sections of aluminum.
  - b. Secure interior face of 12 inches section in horizontal position.
  - c. Apply heat tape to exterior face to control surface temperature at 180 degrees F 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
  - d. Apply load to bearing plate centered on portion of glazing pocket to exterior side of thermal barrier, using a Universal Testing machine set in the 12,000 pound load range.
  - e. Test results: No loss of bond at 3900 pound load applied at strain rate of 0.05 inches/IN/MIN.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Set units plumb, level, and true to line.
- C. Anchor securely in place.
- D. Separate metal surfaces from sources of corrosion or electrolytic action.
  - 1. See Section 09 96 00.
- E. Set sill and base members in a bed of sealant.
- F. Provide joint fillers or gaskets for weathertight construction.
- G. Seal all joints within and at perimeter of system.
- H. Provide sealant color to match finish of system at exposed locations.
- I. Provide sealants compatible with aluminum system and recommended for use with this type of installation.
- J. See Section 07 92 00 for sealants.

### **3.2 FIELD QUALITY CONTROL**

- A. Installation supervised or inspected by manufacturer's authorized representative.

**END OF SECTION**

## **SECTION 08 70 00**

### **FINISH HARDWARE**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Finish hardware.
  - 2. Inspection and testing of door operation.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 08 15 00 – Fiberglass Reinforced Plastic (FRP) Doors and Frames
  - 4. Section 08 11 00 – Hollow Metal Doors and Frames

##### **1.2 QUALITY ASSURANCE**

- A. All door hardware shall be provided by a single hardware supplier.
  - a. Specification Section 08 15 00.
- B. Referenced Standards:
  - 1. Americans with Disabilities Act (ADA):
    - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
  - 2. ICC / ANSI A117.1 – Accessibility and Usable Buildings and Facilities.
  - 3. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
    - a. A156.1, Butts and Hinges.
    - b. A156.3, Exit Devices.
    - c. A156.4, Door Controls -Closers.
    - d. A156.6, Architectural Door Trim.
    - e. A156.8, Door Controls - Overhead Stops and Holders.
    - f. A156.13, Mortise Locks and Latches Series 1000.
    - g. A156.14, Deadbolts
    - h. A156.18, Materials and Finishes.
    - i. A156.21, Thresholds.
    - j. A156.26, Continuous Hinges.
    - k. A156.36, Auxiliary Locks
  - 4. American National Standards Institute/Steel Door Institute (ANSI/SDI).
    - a. A250.8, Specifications for Standard Steel Doors and Frames (SDI-100).
  - 5. Door and Hardware Institute (DHI).
  - 6. National Fire Protection Association (NFPA):
    - a. 101, Life Safety Code.
  - 7. Building code:
    - a. 2015 International Building Code including all amendments, referred to herein as Building Code.
- C. Qualifications:
  - 1. Installation shall be inspected by a certified Architectural Hardware Consultant (AHC).

##### **1.3 DEFINITIONS**

- A. AHC: Architectural Hardware Consultant, certified by DHI.
- B. Installer or Applicator:

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  2. Installer and applicator are synonymous.
- C. All weather: Capable of operation from -50 to +120 DEGF.
- D. Active Leaf: Right-hand leaf when facing door from keyed side unless noted otherwise on Drawings.

#### **1.4 SUBMITTALS**

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Qualifications
    - a. AHC qualifications.
  3. Certification from AHC stating:
    - a. All door hardware has been reviewed by AHC and verified to be compatible with doors and frames.
    - b. No submittals will be reviewed until Owner has received AHC certification.
  4. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  5. Schedule of all hardware being used on each door.
    - a. Number hardware sets and door references same as those indicated on Drawings.
  6. Technical data sheets on each hardware item proposed for use.
  7. Warranty information for all hardware devices having extended warranties.
- B. Informational Submittals:
1. Certifications:
    - a. Certification from AHC stating all door hardware has been provided per approved Shop Drawings, has been installed in accordance with manufacturer's recommended installation instructions and all doors have been inspected and tested and found to be in proper working order.
      - 1) Door assemblies required to swing in the direction of egress have been inspected and tested in accordance with NFPA 101.
- C. Contract Closeout Information:
1. Operation and Maintenance Data:
    - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

#### **1.5 WARRANTY**

- A. Provide all individual manufacturers' extended warranties as advertised.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Hinges:
    - a. Hager Hinge Co.
    - b. McKinney Manufacturing Co.
    - c. Stanley Works.
  2. Locksets and latchsets:
    - a. Best Access Systems.
    - b. Corbin/Ruswin.



3. Exit devices:
  - a. Corbin/Ruswin.
  - b. Precision.
  - c. Sargent.
  - d. Von Duprin, Inc.
4. Closers:
  - a. Corbin/Ruswin.
  - b. LCN.
  - c. Norton.
5. Door stops and holders:
  - a. Trimco.
  - b. Rockwood.
  - c. Ives.
6. Overhead stops:
  - a. Glynn-Johnson Corp.
  - b. Rockwood.
  - c. Trimco.
  - d. Rixson.
7. Weatherstripping and thresholds:
  - a. Pemko Manufacturing Co.
  - b. Reese Enterprises, Inc.
  - c. Zero Weatherstripping, Inc.
  - d. National Guard Products, Inc.
8. Door bolts, coordinators and strikes:
  - a. Ives.
  - b. Trimco.
  - c. Hager.
  - d. Rockwood.
  - e. Dorma.
9. Dead bolts:
  - a. Ives.
  - b. Trimco.
  - c. Hager.
  - d. Rockwood.
  - e. Dorma.
10. Other materials: As noted.

B. Submit request for substitution in accordance with Specification Section 00 72 13.

## 2.2 MATERIALS

- A. General: As indicated in the FABRICATION Article in PART 2 of this Specification Section.
- B. Fasteners: Stainless steel or aluminum.
- C. Closers:
  1. Corrosion resistant closer:
    - a. Body: Aluminum.
    - b. All other components and fasteners: Stainless steel.
    - c. Closer arm bushing: Bronze.
- D. Kickplates:
  1. Stainless steel.
- E. Thresholds: Aluminum.
- F. Overhead Stops and Wall Stops: Stainless steel or aluminum.
- G. Keys: Brass or bronze.

- H. Weatherstripping and Smoke Seals: Polypropylene, neoprene, or EPDM.
- I. Pulls and Push Plates: Stainless steel.
- J. Silencers: Rubber.

## 2.3 COMPONENTS

- A. Hinges:
  - 1. Butt hinges:
    - a. ANSI/BHMA A156.1.
      - 1) A5111: Stainless steel, full-mortise, anti-friction bearing, Grade 1.
    - b. Ball bearing.
    - c. Flat button tips.
    - d. Butt hinges:
      - 1) Hager BB1199.
      - 2) McKinney T4B3386.
    - e. Hinge size:
      - 1) Doors up to and including 46 IN wide: 4.5 IN x 4.5 IN.
      - 2) Doors over 46 IN up to and including 60 IN wide: 5 IN high x 4.5 IN.
- B. Mortise Locks and Latches:
  - 1. ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1.
    - a. Meet requirements of ADA.
  - 2. Antifriction two-piece mechanical latchbolt with stainless steel anti-friction insert.
    - a. One-piece stainless steel deadbolt, minimum 1-1/4 IN x 9/ 16 IN thick with 1 IN throw.
    - b. 2-3/4 IN backset.
    - c. Cylinder: Brass, 6 pin, with interchangeable core.
    - d. ADA compliant thumb turn lever.
  - 3. Locking, latching and retracting mechanism and lock case:
    - a. Corrosion resistant: Non-ferrous lock case.
      - 1) Provide non-ferrous lock case on doors scheduled to receive corrosion resistant closers.
  - 4. Trim design: Corbin/Russwin "NSP".
    - a. Functions as indicated in following table in accordance with ANSI/BHMA A156.13.

MORTISE LOCK NUMBERS		
ANSI	FUNCTION	CORBIN/RUSSWIN
F01	Passage	ML2010
F19	Privacy	ML2030
F05	Classroom	ML2055
F07	Storeroom	ML2057
F13	Entrance or Office	ML2065

- C. Exit Devices:
  - 1. ANSI/BHMA A156.3, Grade 1.
  - 2. Single doors: Mortise.
  - 3. Pairs of doors: Concealed vertical rods.
  - 4. Trim: Sargent "ET".
    - a. Lever operation.
    - b. Lever style: Sargent "L".
  - 5. Sargent "80 Series".
    - a. Function as indicated on Hardware Schedule.

- D. Bolts:
  - 1. ANSI/BHMAA 156.16.
  - 2. Surface bolts: Rockwood 580 Series with top and bottom strikes.
  - 3. Automatic flush bolts:
    - a. Rockwood 2842.
    - b. Provide extended bolt length on doors over 84 IN tall.
- E. Coordinator:
  - 1. Ives "Cor Series" or Rockwood 1600 Series.
  - 2. Provide filler bar as required.
  - 3. Finish of coordinator and filler bar to be anodized aluminum color to match other hardware finishes.
  - 4. Mounting brackets as required.
- F. Door Closers:
  - 1. ANSI/BHMA A156.4, Grade 1.
  - 2. Size door closers to comply with ANSI recommendations for door size and location.
  - 3. Fabricate all closers with integral back check.
  - 4. Provide integral stop unless noted otherwise.
    - a. Do not provide integral stop at closers indicated to be installed on pull side of door.
    - b. Provide all weather fluid for all closers used in exterior doors and all doors identified to be insulated.
  - 5. Full cover.
    - a. Manufacturer's standard plastic cover.
  - 6. Arms, brackets, and plates: As required for complete installation.
  - 7. Closers:
    - a. Corrosion resistant: Norton 7500 SS Series.
  - 8. Provide manufacturer's standard 10 year warranty.
- G. Door Stops:
  - 1. ANSI/BHMA A156.16.
    - a. Wall stops: Ives WS406-CVX or WS406-CCV.
- H. Overhead Door Holders/Stop:
  - 1. ANSI/BHMA A156.8.
  - 2. Provide 'hold-open' function on all stops unless noted otherwise.
    - a. Do not provide 'hold-open' function at fire rated doors.
  - 3. Surface mounted stops: Rockwood N14400 Series or Glynn Johnson 90 Series.
  - 4. Concealed stops: Rockwood N11000 Series or Glynn Johnson 100 Series.
- I. Kickplates:
  - 1. ANSI/BHMA A156.6.
  - 2. 8 IN high x 2 IN less than door width.
  - 3. Beveled on all edges.
  - 1. Thickness:
    - a. Stainless steel: 0.050 IN.
- J. Thresholds:
  - 1. ANSI/BHMA A156.21.
  - 2. One-piece unit.
  - 3. Height: 1/2 IN high maximum.
  - 4. Width: 5 IN
  - 5. Provide required bolt cutouts.
- K. Astragal: UL listed for labeled doors.
  - 1. Coated with minimum 15 MIL gel coating per Specification Section 08 15 00.
- L. Weatherstripping:

1. Weather seal at jambs and head:
  - a. Self-adhesive strip: Reese #797W.
  - b. Color: Black.
2. Sweep at bottom of doors:
  - a. Reese 701.
  - b. Color: Clear anodized
3. Weather seal astragal at meeting edges of pairs of doors:
  - a. Reese 92 each leaf.
  - b. Color: Clear anodized

## **2.4 ACCESSORIES**

### **A. Silencers:**

1. FRP frames: Trimco 1229A or Rockwood 608.
2. Self-adhesive silencers are not acceptable.

### **B. Keying:**

1. Establish keying with USER.
  - a. Provide and set up complete visible card indexed system with key tags and control slips.
  - b. Tag and identify keys.
  - c. Provide two (2) keys for each lock or cylinder.
  - d. Master key and key in groups as directed.
  - e. Provide construction master keys for all exterior doors.

### **C. Strikes:**

1. Curved lips.
  - a. Extended lips when required.
2. Furnish strike boxes.
3. Appropriate for function and hardware listed.

## **2.5 FABRICATION**

### **A. General:**

1. Generally prepare for Phillips head machine screw installation.
2. Exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of other work as closely as possible.
3. For mineral core doors use screws which thread to head to apply butt hinges.
4. Provide concealed fasteners unless thru bolted.
5. Through bolt closers on all doors.
6. Furnish items of hardware for proper door swing.
7. Furnish lock devices which allow door to be opened from inside room without a key or any special knowledge.

### **B. Hardware:**

1. Provide following ANSI/BHMA A156.18 finishes:
  - a. Locksets, latchsets and strikes: 630.
  - b. Door pulls, push bars, push plates: 630.
  - c. Kickplates:
    - 1) Stainless steel: 630.
  - d. Exit devices: 630 where available; 626 if 630 is not available.
    - 1) Provide 630 finish on trim.
  - e. Butt hinges: 630.
  - f. Door stops, dead locks, mortise bolts, and miscellaneous hardware: 630 where available, 626 if 630 not available.
  - g. Door overhead stops: 630.
  - h. Closers: 600 prime coat with 689 finish coat, unless noted otherwise.

- 1) Corrosion resistant closers: 630.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's installation instructions.
  1. Perform installation by or under the direct supervision of an AHC.
- B. Provide all hardware in accordance with Building Code.
- C. Fit hardware before final door finishing.
- D. Permanently install hardware after door finishing operations are complete.
- E. Locate hardware in accordance with ANSI/SDI A250.8.
- F. Butt Hinges:
  1. Provide non-removable pin (NRP) at:
    - a. Exterior doors.
    - b. Reverse handed doors equipped with locks.
  2. Quantities:
    - a. Door height 61 - 90 IN: Three (3).
    - b. Door height 91 - 114 IN: Four (4).
    - c. Door height 115 - 144 IN: Five (5).
    - d. Doors over 48 IN wide and over 96 IN high:
      - 1) Provide top butt hinge within 6 IN of the top of the door to top of hinge.
      - 2) Provide one (1) additional butt hinge approximately 6 IN below the bottom of the top butt hinge.
- G. Closers:
  1. Mount closers on push side of doors unless noted otherwise.
- H. Provide coordinator when required by hardware specified.
- I. Overhead Stops:
  1. Provide overhead stop when corrosion resistant closer is specified.
  2. Provide concealed overhead stop on doors scheduled to receive closer mounted on pull side of door.
  3. Provide at interior doors not scheduled to receive a closer as follows:
    - a. Doors that swing more than 105 DEG without encountering a wall or obstruction.
      - 1) Stop shall limit swing of door from impacting wall or obstruction.
    - b. Inactive leafs of pairs of doors.
- J. Wall Mount Door Stops:
  1. Provide where specifically indicated on Hardware Schedule and at doors not otherwise indicated to receive:
    - a. Overhead stop.
    - b. Closer with integral stop.
- K. Floor mounted stops are not acceptable unless noted otherwise in this Specification Section.
- L. Provide silencers for door frames.
  1. FRP frames: See Specification Section 08 15 00.
- M. Provide weather seal, door sweep and threshold at all exterior doors and where scheduled on interior doors.
  1. Set thresholds in a full bed of sealant.
  2. Mount door sweeps on exterior face of door.
  3. Mount weather seal astragal at meeting edges of pairs of doors on the exterior face of the doors.

N. Mount kickplates on push side of doors.

### 3.2 FIELD QUALITY CONTROL

- A. Adjust and check each operating item of hardware to assure proper operation or function.
1. Lubricate moving parts with lubricant recommended by manufacturer.
- B. During week prior to startup, make a final check and adjustment of all hardware items.
1. Clean and lubricate as necessary to assure proper function and operation.
  2. Adjust door control devices to compensate for operation of heating and ventilating equipment.
- C. Inspection and Testing:
1. AHC shall inspect and test all door assemblies and provide written certification that door assemblies are in proper working order.
    - a. Door assemblies required to swing in the direction of egress shall be inspected and tested in accordance with NFPA 101.
  2. Submit documentation and certification of testing in accordance with the certifications paragraph in the SUBMITTALS Article in PART 1 of this Specification Section.

### 3.3 SCHEDULES

A. Hardware Schedule:

HARDWARE SCHEDULE			
Hardware Set	Quantity	Unit	Description
HW-1	3	PR	Butts
	1	EA	Mortise Lockset – Storeroom Function (Active Leaf)
	1	EA	Closer w/Stop / Hold Open – Push Side Mounted
	1	EA	Weatherstripping
	1	EA	Astragal (Weatherstripped)
	1	EA	Threshold
	1	EA	Coordinator
	1	EA	Flush Bolts (Inactive Leaf)
	1	EA	Sweep
	1	EA	Drip Cap
HW-2	1 1/2	PR	Butts
	1	EA	Mortise Lockset – Passage Function
	1	EA	Door closer with hold open
	1	EA	Smoke seals
HW-3	1 1/2	PR	Butts
	1	EA	Exit Device
	1	EA	Closer w/Stop / Hold Open – Push Side Mounted
	1	EA	Weatherstripping
	1	EA	Threshold
	1	EA	Sweep
	1	EA	Drip Cap

HARDWARE SCHEDULE			
Hardware Set	Quantity	Unit	Description
HW-4	1-1/2	PR	Butts
	1	EA	Mortise Lockset – Entry Function
	1	EA	Closer w/Stop / Hold Open – Push Side Mounted
	1	EA	Weatherstripping
	1	EA	Threshold
	1	EA	Sweep
	1	EA	Drip Cap
HW-5	1 1/2	PR	Butts
	1	EA	Mortise Lockset – Entry Function
	1	EA	Closer w/Stop / Hold Open – Push Side Mounted
	1	EA	Weatherstripping
	1	EA	Threshold
	1	EA	Sweep
	1	EA	Drip Cap

**END OF SECTION**

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## **SECTION 08 90 00**

### **LOUVERS AND VENTS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Louvers and vents.
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Division 07 42 14 – Insulated Metal Wall Panels
  - 3. Section 07 62 00 - Flashing and Sheet Metal.
  - 4. Section 07 92 00 - Joint Sealants.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Architectural Manufacturers Association (AAMA):
    - a. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
  - 2. Air Movement and Control Association (AMCA).
  - 3. ASTM International (ASTM):
    - a. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

##### **1.3 DEFINITIONS**

- A. PVDF: Polyvinylidene fluoride.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Drawing showing location of each louver or vent, indicating size and arrangement of blank-off plates if required.
  - 3. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Color chart showing manufacturer's full line of colors including exotic and special colors for color selection by USER.
- B. Samples:
  - 1. Samples of factory applied high performance organic coatings of colors proposed for matching color of roofing panels.
    - a. Provide actual metal samples (aluminum).
      - 1) Color cards and computer generated color reproductions are not acceptable.
- C. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
  - 2. Warranty information for PVDF coatings.
- D. Factory applied high performance organic coatings utilizing PVDF resins shall be provided with manufacturer's standard 10 year warranty against color fade, chalking and film integrity.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Louvers:
    - a. Airolite Co.
    - b. Construction Specialties, Inc.
    - c. Ruskin Manufacturing.
    - d. Industrial Louvers, Inc.
    - e. American Warming.
    - f. Greenheck.
- B. Submit request for substitution in accordance with Specification Section 00 72 13.

### **2.2 MANUFACTURED UNITS**

- A. Louvers:
  - 1. See schedule in the Drawings for information not found in this section.
  - 2. Drainable with blades at 37-1/2 DEG or 45 DEG.
  - 3. Continuous blade appearance.
  - 4. ASTM B221 extruded aluminum, alloy 6063T5, minimum 0.063 IN thick.
  - 5. Water penetration: 0.01 OZ/SF at 873 FPM.
  - 6. AMCA certified.
  - 7. Insect screen:
    - a. 18-16 mesh aluminum.
    - b. Install in standard aluminum frame.
  - 8. Bird screen:
    - a. 1/2 IN square mesh.
    - b. 16 GA aluminum.
    - c. Install in standard frame.
- B. Anchors, Fasteners, Reinforcing: Aluminum or stainless steel.
- C. Finish:
  - 1. Meet requirements of AAMA 2605.
    - a. PVDF coating with minimum 70 PCT resin content.
    - b. Color: Match insulated metal wall panels (as selected by USER).
- D. Size: Refer to Mechanical Drawings for louver size, and refer to Architectural Drawings for louver elevations.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchoring and bracing accessories as required.
- C. Seal around perimeter on exterior and interior.
  - 1. See Section 07 92 00.
- D. Install 0.040 IN aluminum flashing at sill to match louver.
  - 1. See Section 07 62 00.

**END OF SECTION**



DIVISION 09

**FINISHES**



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**SECTION 09 77 61**  
**FIBERGLASS REINFORCED PLASTIC (FRP) PANELS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish labor, materials, tools, equipment, and services for Fiberglass Reinforced Plastic Panels, as indicated, in accordance with provisions of the Contract Documents.
- B. Completely coordinate with work of other trades.

**1.2 QUALITY ASSURANCE**

- A. ASTM Standards:
  - 1. ASTM D570 Standard Test Method for Water Absorption of Plastics
  - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

**1.3 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's literature indicating material and fire test information in compliance with specifications.
- B. Samples:
  - 1. Two 12 IN 300 x 300 MM square pieces of each pattern and color as specified in Drawing I-001 Interior Notes and Finish Legend.
  - 2. Material samples of full range of standard and custom range of for selection of colors.
- C. Contract Closeout Information:
  - 1. Interior finish fire performance data:
    - a. Provide for each finish material and type specified:
      - 1) Manufacturer's printed information including:
        - a) Fire class.
        - b) NFPA test number.
      - 2) See Section 01 77 00.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Fiberglass Reinforced Plastic Panels:
  - 1. Base:
    - a. Crane Composites.
  - 2. Optional:
    - a. Marlite.
    - b. Glasteel.
    - c. Kal-Lite.
    - d. Nudo.
    - e. Graham.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

**2.2 MATERIALS**

- A. Class A Fiberglass Reinforced Plastic (FRP) Wall and Ceiling Panels:
  - 1. For use on walls and ceilings, see Room Finish Schedule for locations.
  - 2. Panel thickness:
    - a. 0.09 IN 2.3 MM.

3. Barcol hardness not less than 50.
  4. Interior finish rating: Class A (I) when tested in accord with ASTM E84:
    - a. Flame spread: Less than 25.
    - b. Smoke developed: Less than 450.
  5. Water absorption no greater than 0.20 PCT at 24 HRS at 77 DEGF 25 DEGC in accordance with ASTM D570.
  6. Identify boards by manufacturer's standard marking on reverse side of panel.
  7. Embossed finish (verify with USER).
  8. Color: White.
  9. Adhesive:
    - a. Compatible with panels and substrate.
    - b. As recommended by panel manufacturer.
  10. Base product: Fire-X Glasbord by Crane Composites.
- B. Moldings:
1. Manufacturer's standard extruded vinyl trim.
  2. All moldings to be set in sealant as recommended by FRP manufacturer.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Verify suitability of substrate to accept installation.
- B. Correct unsatisfactory conditions.
- C. Start of installation indicates acceptance of responsibility for performance.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's recommendations and approved shop drawings.
- B. Install moldings to panels prior to erection.
  1. Apply moldings to panel edges.
  2. Apply silicone sealant to manufacturer's recommendations.
- C. Apply adhesive full coverage at panel back.

### **3.3 CLEANING**

- A. Remove excessive sealant and adhesive with cleaner recommended by panel manufacturer.
- B. Clean entire surface prior to closeout.

## **END OF SECTION**

**SECTION 09 91 10**  
**ARCHITECTURAL PAINTING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Surface Preparation.
  - 2. Field application of:
    - a. Architectural Coatings.
    - b. Special Coatings.
    - c. Stains and varnishes.
    - d. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.
  - 3. Environmental controls for field application of coatings.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 03 - Concrete.
  - 2. Division 04 - Masonry.
  - 3. Section 08 11 00 - Metal Doors and Frames.
  - 4. Section 09 96 00 - High Performance Industrial Coatings.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. D523, Standard Test Method for Specular Gloss.
    - b. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
    - c. D4259, Standard Practice for Abrading Concrete.
    - d. D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.
    - e. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
    - f. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
    - g. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
    - h. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 2. National Fire Protection Association (NFPA):
    - a. 101, Life Safety Code.
  - 3. Steel Door Institute/American National Standards Institute (SDI/ANSI):
    - a. A250.10, Test Procedure and Acceptance Criteria For Prime Painted Steel Surfaces for Steel Doors and Frames.
  - 4. The Society for Protective Coatings (SSPC):
    - a. SP 1, Solvent Cleaning.
    - b. SP 2, Hand Tool Cleaning.
    - c. SP 3, Power Tool Cleaning.
    - d. SP 16, Brush-off Blast Cleaning of Non-Ferrous Metals.
  - 5. The Society for Protective Coatings/NACE International (SSPC/NACE):
    - a. SP 6/NACE No. 3, Commercial Blast Cleaning.
    - b. SP 7/NACE No. 4, Brush-off Blast Cleaning.
    - c. SP 13/NACE No. 6, Surface Preparation of Concrete.
  - 6. United States Environmental Protection Agency (EPA).
- B. Miscellaneous:

1. Coating used in all corridors and stairways shall meet requirements of NFPA 101 and ASTM E84.

### **1.3 DEFINITIONS**

- A. Installer or Applicator:
  1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  2. Installer and applicator are synonymous.
- B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified.
- C. Exposed Exterior Surface:
  1. Exterior surface which is exposed to view.
  2. Exterior surface which is exposed to weather but not necessarily exposed to view.
- D. Finished Area:
  1. An area that is listed in or has finish called for on Room Finish Schedule.
  2. An area that is indicated on Drawings to be painted.
- E. Gloss Range:
  1. Specular gloss measured in accordance with ASTM D523:
    - a. Flat: Below 15, at 60 degrees.
    - b. Eggshell: Between 20 and 35, at 60 degrees.
    - c. Semi-gloss: Between 35 and 70, at 60 degrees.
    - d. Gloss: More than 70, at 60-degrees.
- F. Paint includes the following:
  1. Architectural paints (AP) include: Acrylic latex or alkyd enamel coatings.
  2. Special coatings (SC) include: Water-based pigmented resin particles suspended in acrylic latex solution.
  3. Stains and varnish include: Alkyd stain and polyurethane varnish.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's surface preparation instructions.
    - c. Manufacturer's application instructions.
- B. Samples:
  1. Manufacturer's full line of colors for Engineer's preliminary color selection.
  2. Gloss samples.
  3. After preliminary color selection by Engineer provide two (2) 8 by 10 inches samples of each final color and sheen selected.
- C. Informational Submittals:
  1. Test results.
  2. Applicator's daily records:
    - a. Submit daily records at end of each week in which painting work is performed unless requested otherwise by Engineer's on-site representative.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver in original containers, labeled as follows:
  1. Name or type number of material.
  2. Manufacturer's name and item stock number.
  3. Contents, by volume, of major constituents.
  4. Warning labels.



5. VOC content.
- B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.

## **1.6 PROJECT CONDITIONS**

- A. Verify that atmosphere in area where painting is to take place is within paint manufacturer's acceptable temperature, humidity and sun exposure limits.
  1. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
    - a. Provide temporary dehumidification equipment properly sized to maintain humidity levels required by paint manufacturer.
    - b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 hour basis.
      - 1) Vent exhaust gases to exterior environment.
      - 2) No exhaust gases shall be allowed to vent into the space being painted or any adjacent space.
  2. Do not apply coatings in snow, rain, fog or mist.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Provide products from a single manufacturer to the greatest extent practicable.
- B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Architectural paints:
    - a. Benjamin Moore & Co.
    - b. PPG.
    - c. Pratt & Lambert.
    - d. Sherwin-Williams.
    - e. Tnemec, Inc.
  2. Special coatings:
    - a. Master Coating Technologies, Inc. - Zolatone.
    - b. Dryvit Systems, Inc.
  3. Stains and varnish:
    - a. Benjamin Moore & Co.
    - b. PPG IdeaScapes.
    - c. Pratt & Lambert.
    - d. Sherwin-Williams.

### **2.2 MATERIALS**

- A. General:
  1. For unspecified materials such as thinner, provide manufacturer's recommended products.
  2. Unless noted otherwise, products listed are manufactured by the manufacturer listed below.
    - a. Products of other manufacturers will be considered for use provided that the product:
      - 1) Is of the same generic formulation.
      - 2) Has comparable application requirements.
      - 3) Meets the same VOC levels or better.
      - 4) Provides the same finish and color options.
  3. Coatings shall comply with the VOC limits of EPA:
  4. Colors:
    - a. Colors and gloss will be selected from the manufacturer's complete offering, including special colors and premium offerings.
- B. Architectural Paints:

1. Product List:

Generic Description	Product
Acrylic Primer	PPG Pure Performance 9-900
Acrylic Latex	PPG Pure Performance 9-100/9-300/9-500 Series
Acrylic Gloss	PPG Speedhide 6-8534 Series
Concrete Filler/Surfacer	Tnemec Series 215 and/or Series 218
CMU Block Filler	Tnemec Series 54 Masonry Filler
Dry-Fall Primer	Tnemec Series V115 Uni-Bond DF
Epoxy Barrier Coat	Tnemec Series 135 Chembuild
Fluoropolymer	Tnemec Series 1070V/1071V/1072V Fluoronar
HDP Acrylic	Tnemec Series 1028/1029 Enduratone
Organic Zinc Primer	Tnemec Series 94-H2O Hydro-Zinc
Polycarbamide	Tnemec Series 740/750 UVX
Waterborne Acrylate	Tnemec Series 156 Enviro-Crete

C. Special Coatings:

1. Product List:

Generic Description	Product
Special Coating Acrylic Primer	Zolatone SP203 Acrylic Basecoat.
Special Coating Stain Blocker	Zolatone SP222 Eco-Block.
Special Coating Base Coat	Zolatone Flex Base Coat.
Special Coating Finish Coat	Zolatone Flex Finish Coat.

D. Stains and Varnishes:

1. Product List:

Generic Description	Product
Sanding sealer	PPG Olympic 41061 Premium Interior Water Based Sanding Sealer
Alkyd Wood Stain	PPG Olympic 44500 Premium Interior Oil Based Wood Stain
Polyurethane Varnish	PPG Olympic 42786 Premium Interior Water Based Polyurethane Clear Satin

## 2.3 PAINT SYSTEMS

A. General:

1. Refer to Specification Section 09 96 00 for:
  - a. Items in corrosive or highly corrosive environments.
  - b. Items subject to immersion service.
  - c. Items subject to exterior exposure.
  - d. Any other locations where High Performance Industrial Coatings (HPIC) are required.

B. Schedule:

Substrate	Prime Coat <sup>1</sup>	Intermediate Coat(s) <sup>1</sup>	Finish Coat <sup>1</sup>
Concrete	Concrete Filler/Surfacer as necessary to fill all voids and depressions	100 to 200 square feet/GAL Waterborne Acrylate	100 to 200 square feet/GAL Waterborne Acrylate
Concrete Masonry	80 to 100 square feet/GAL CMU Block Filler	100 to 200 square feet/GAL Waterborne Acrylate	100 to 200 square feet/GAL Waterborne Acrylate
Structural Steel and Miscellaneous Metals <sup>3</sup>	2.5 to 3.5 mil Organic Zinc Primer	2.0 to 3.0 mil HDP Acrylic <sup>2</sup>	2.0 to 3.0 mil HDP Acrylic <sup>2</sup>
Galvanized Structural Steel and Miscellaneous Metals <sup>3</sup>	2.0 to 4.0 mil Dry-Fall Acrylic	XX	2.0 to 3.0 mil HDP Acrylic <sup>2</sup>
Galvanized Metal Deck <sup>3</sup>	2.0 to 4.0 mil Dry-Fall Acrylic	XX	2.0 to 4.0 mil Dry-Fall Acrylic
Factory Primed Metal Deck <sup>3</sup>	XX	2.0 to 4.0 mil Dry-Fall Acrylic	2.0 to 4.0 mil Dry-Fall Acrylic
Galvanized Steel Railings	4.0 to 6.0 mil Epoxy Barrier Coat	2.5 to 3.5 mil Polycarbamide Gloss	2.5 to 3.5 mil Polycarbamide Gloss
Steel Railings	4.0 to 6.0 mil Epoxy Barrier Coat	2.0 to 3.0 mil HDP Acrylic Gloss	2.0 to 3.0 mil HDP Acrylic Gloss
Exposed wood indicated to be painted	300 to 400 square feet/GAL Acrylic Primer	300 to 400 square feet/GAL Acrylic Gloss	300 to 400 square feet/GAL Acrylic Gloss
Exposed wood indicated to be stained	400 to 500 square feet/GAL Sanding Sealer	Two coats at 400 to 500 square feet/GAL Alkyd Wood Stain	Two coats at 400 to 500 square feet/GAL Polyurethane Varnish
Hollow Metal - Interior	4.0 to 5.0 mil DFT Epoxy Barrier Coat	2.0 to 3.0 mil HDP Acrylic <sup>2</sup>	2.0 to 3.0 mil HDP Acrylic <sup>2</sup>
Hollow Metal - Exterior	4.0 to 5.0 mil DFT Epoxy Barrier Coat	2.5 to 3.5 mil Polycarbamide <sup>2</sup>	2.5 to 3.5 mil Polycarbamide <sup>2</sup>
Sectional Overhead Doors	4.0 to 5.0 mil DFT Epoxy Barrier Coat	XX	2.0 to 3.0 mil DFT Fluoropolymer <sup>2</sup>
Gypsum Board scheduled to receive "AP"	300 to 400 square feet/GAL Acrylic Primer	300 to 400 square feet/GAL Acrylic Latex <sup>2</sup>	300 to 400 square feet/GAL Acrylic Latex <sup>2</sup>
Gypsum Board scheduled to receive "SC"	250 to 350 square feet/GAL Special Coating Acrylic Primer	250 to 300 square feet/GAL Special Coating Base Coat	125 to 150 square feet/GAL Special Coating Finish Coat

1. Application rates (SF/GAL) shown are for unthinned materials.

2. Sheen as scheduled or selected.

## PART 3 - EXECUTION

### 3.1 ITEMS TO BE PAINTED

A. Exterior surfaces, including but not limited to:

- Concrete:

- a. Where indicated on Drawings.
  - 2. Concrete masonry:
    - a. Where indicated on Drawings.
  - 3. Structural steel:
    - a. Columns, beams and bracing.
    - b. Field welded connections of factory painted structural steel.
  - 4. Steel railings.
  - 5. Galvanized steel railings.
  - 6. Miscellaneous ferrous metal surfaces:
    - a. Items specifically noted on Drawings to be painted.
  - 7. Miscellaneous galvanized steel surfaces:
    - a. Pipe Bollards.
    - b. Embed Plates.
    - c. Loose lintels.
    - d. Steel components of concrete lintels.
    - e. Items specifically noted on Drawings to be painted.
  - 8. Doors and frames:
    - a. Hollow metal doors and frames.
    - b. Hollow metal window frames.
- B. Interior Areas:
- 1. Refer to Room Finish Schedule on Drawings.
    - a. If space is scheduled to be painted, paint all appurtenant surfaces within the space unless specifically noted otherwise.
    - b. Provide coating manufacturer's recommended bonding primer.
    - c. Appurtenant surfaces include but are not limited to:
      - 1) Columns, beams, bracing and similar components.
      - 2) Underside of roof or floor decks above.
      - 3) Conduit, boxes, covers and supports.
      - 4) Ductwork, duct insulation and duct supports.
      - 5) Piping, pipe insulation and jacketing.
      - 6) Miscellaneous ferrous metal surfaces.
  - 2. Concrete walls and columns.
  - 3. Concrete masonry.
  - 4. Doors and frames:
    - a. Hollow metal doors and frames
    - b. Hollow metal window frames.
    - c. Four-fold industrial doors.
    - d. Sectional overhead doors.

### **3.2 ITEMS NOT TO BE PAINTED**

- A. General: Do not paint items listed in this Article, unless noted otherwise.
- B. Items with Approved Factory Finish: These items may require repair of damaged painted areas or painting of welded connections.
- C. Electrical equipment.
- D. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.
- E. Code labels, equipment identification or rating plates and similar labels, tagging and identification.
- F. Contact surfaces of friction-type structural connections.
- G. Stainless steel surfaces.
- H. Aluminum Surfaces Except:

1. Where specifically shown in the Contract Documents.
  2. Where in contact with concrete.
  3. Where in contact with dissimilar metals.
  4. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.
- I. Fiberglass Surfaces Except:
1. Fiberglass piping where specifically noted to be painted.
  2. Piping supports where specifically noted to be painted.
  3. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.
- J. Galvanized steel items, unless specifically noted to be painted.
- K. Architectural finishes:
1. Exterior concrete indicated to receive another finish.
  2. Precast concrete surfaces, unless specifically indicated to be painted.
  3. Prefinished masonry surfaces:
    - a. Precolored masonry (exterior face).
      - 1) Interior face shall be painted where scheduled.
    - b. Burnished (ground face) concrete masonry.
    - c. Prefaced masonry.
    - d. Face brick.
    - e. Glass masonry.
  4. Plastic laminate.
  5. Solid surface material.
  6. Standing and running trim.
  7. Fiberglass fabrications.
  8. Anodized aluminum.
  9. PVDF coated metals.
  10. Factory finished doors and frames.
  11. Aluminum windows, curtainwall and storefront framing systems.
  12. Finish hardware.
  13. Glass and glazing.
  14. Ceramic, porcelain, quarry tile or natural stone.
  15. Acoustical materials.
  16. Building specialties.
  17. Louvers.
  18. Casework and countertops.
  19. Pipe insulation and jacketing.
  20. Standing seam metal roof, fascia, trim, soffit and accessories.

### 3.3 EXAMINATION

- A. Concrete:
1. Test pH of surface to be painted in accordance with ASTM D4262.
    - a. If surface pH is not within paint manufacturer's required acceptable range, use methods acceptable to paint manufacturer as required to bring pH within acceptable range.
    - b. Retest pH until acceptable results are obtained.
  2. Verify that moisture content of surface to be painted is within paint manufacturer's recommended acceptable limits.
    - a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
      - 1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869.
      - 2) Provide remedial measures as necessary to bring moisture content within paint manufacturer's recommended acceptable limits.
      - 3) Retest surface until acceptable results are obtained.
- B. Concrete Unit Masonry:

1. Test pH of surface to be painted in accordance with ASTM D4262.
  - a. If surface pH is not within paint manufacturer's required acceptable range, use methods acceptable to paint manufacturer as required to bring pH within acceptable limits.
  - b. Retest pH until acceptable results are obtained.
2. Verify that moisture content of surface to be painted is within paint manufacturer's recommended acceptable limits.
  - a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
    - 1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869.
    - 2) Provide remedial measures as necessary to bring moisture content within paint manufacturer's recommended acceptable limits.
    - 3) Retest surface until acceptable results are obtained.

### **3.4 PREPARATION**

#### **A. General:**

1. Prepare surfaces to be painted in accordance with paint manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.
  - a. Where discrepancy between paint manufacturer's instructions and this Specification Section exists, the more stringent preparation shall be provided unless approved otherwise, in writing, by the Engineer.
2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of paint to surface.
3. Adhere to manufacturer's recoat time surface preparation requirements.
  - a. Surfaces that have exceeded paint manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional paint in accordance with manufacturer's published recommendations.

#### **B. Protection:**

1. Protect surrounding surfaces not to be coated.
2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
3. Protect code labels, equipment identification or rating plates and similar labels, tagging and identification.

#### **C. Prepare and paint before assembly all surfaces which are inaccessible after assembly.**

#### **D. Existing Surfaces:**

1. Wherever existing work is cut, patched or modified; repair and repaint to match new work.
2. Where a wall or ceiling is disturbed and patched, paint entire wall or ceiling.

#### **E. Wood:**

1. Sandpaper smooth, remove dust.
2. Opaque Finishes:
  - a. Seal all knots, pitch and resinous sapwood after prime coat has dried.
  - b. Putty holes and imperfections; sand smooth.
3. Transparent Finishes:
  - a. Treat wood with compatible wash-coat prior to stain application.
  - b. Putty holes and imperfections to match wood color; sand smooth.

#### **F. Ferrous Metal:**

1. Complete fabrication, welding or burning before beginning surface preparation.
  - a. Chip or grind off flux, spatter, slag or other laminations left from welding.
  - b. Remove mill scale.
  - c. Grind smooth rough welds and other sharp projections.
2. Solvent clean in accordance with SSPC SP 1 to remove all dust, grease, oil, compounds, dirt and other foreign matter.

3. Exterior exposure:
  - a. Commercial blast clean in accordance with SSPC SP 6/NACE No. 3.
4. Interior exposure:
  - a. Hand tool cleaning in accordance with SSPC SP 2 and/or power tool cleaning in accordance with SSPC SP 3.
- G. Hollow Metal:
  1. Solvent clean in accordance with SSPC SP 1 to remove all dust, grease, oil, compounds, dirt and other foreign matter.
  2. Lightly sand primed surfaces with fine grit sandpaper as recommended by hollow metal manufacturer.
- H. Galvanized Steel and Non-ferrous Metals:
  1. Solvent clean to remove all dust, grease, oil, compounds, dirt and other foreign matter.
  2. Brush-off blast in accordance with SSPC SP 16 or hand tool cleaning in accordance with SSPC SP 2 to remove surface contaminants.
- I. Gypsum Wallboard:
  1. Repair minor irregularities left by finishers.
  2. Avoid raising nap of paper face on gypsum wallboard.
  3. Verify moisture content is less than 8% before painting.
  4. After application of prime coat and between subsequent coats, inspect surface and repair holes, dents, irregularities or other defects as necessary to provide a smooth, uniform finish.
- J. Concrete:
  1. Cure for minimum of 28 days.
  2. Clean in accordance with ASTM D4258.
    - a. Remove all soil, grease, oil, or other surface contaminants.
  3. Grind fins and protrusions in accordance with ASTM D4259, flush to plane of wall.
  4. Abrasive blast in accordance with ASTM D4259 and SSPC SP13/NACE No. 6.
    - a. Remove all laitance, efflorescence, scabbing and other foreign matter.
    - b. Provide minimum concrete surface profile CSP 3 per ICRI 310.2.
  5. Test pH and moisture content in accordance with EXAMINATION article in this specification section.
  6. Repair tie holes, voids, bugholes or other surface defects as necessary to provide smooth, uniform surface.
- K. Concrete Unit Masonry:
  1. Cure for minimum of 28 days.
  2. Remove all mortar spatters and protrusions.
  3. Clean in accordance with ASTM D4261.
    - a. Remove all soil, grease, oil, efflorescence.
  4. Test pH and moisture content in accordance with EXAMINATION article in this specification section.

### 3.5 APPLICATION

- A. General:
  1. Thin, mix and apply paints in accordance with manufacturer's installation instructions.
    - a. Where discrepancy exists between manufacturer's instructions and this Specification Section, the more stringent requirement shall apply.
    - b. When materials have been thinned, adjust application rates as necessary to achieve film coverage indicated in Part 2 for unthinned materials.
    - c. Backroll spray applied paints.
  2. Temperature and weather conditions:
    - a. Do not paint surfaces when surface temperature is below 50 degrees F unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and paint manufacturer's authorized representative.

- b. Avoid painting surfaces exposed to hot sun.
    - c. Do not paint on damp surfaces.
  - 3. Apply materials under adequate illumination.
  - 4. Evenly spread to provide full, smooth coverage.
    - a. All paint systems are "to cover."
      - 1) When color or undercoats show through, apply additional coats until paint film is of uniform finish and color.
    - b. Finished paint system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.
  - 5. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
  - 6. Work each application of material into corners, crevices, joints, and other difficult to work areas.
  - 7. When painting rough surfaces, hand brush and backroll paint to work into all recesses.
  - 8. Smooth out runs or sags immediately, or remove and recoat entire surface.
  - 9. Allow preceding coats to dry before recoating.
    - a. Recoat within time limits specified by paint manufacturer.
    - b. If recoat time limits have expired re-prepare surface in accordance with paint manufacturer's printed recommendations.
  - 10. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
  - 11. Finish colors not otherwise indicated shall be selected by Engineer from paint manufacturer's complete offering.
- B. Fillers, surfacers or patching compounds:
- 1. Provide fillers, surfacers or patching compounds in accordance with manufacturer's recommendations and as specified herein as necessary to provide a smooth, defect free substrate.
- C. Prime Coat Application:
- 1. Prime all surfaces indicated to be painted.
    - a. Apply prime coat in accordance with paint manufacturer's written instructions and as written in this Specification Section.
  - 2. Ensure field-applied paints are compatible with factory-applied paints or existing coatings.
    - a. Employ services of coating manufacturer's qualified technical representative.
      - 1) Certify through material data sheets.
      - 2) Perform test patch.
    - b. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.
    - c. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using appropriate paint system listed in the MATERIALS Article, Paint Systems paragraph of this Specification Section.
      - 1) All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.
  - 3. Special coatings prime coat application:
    - a. Prime new gypsum board surfaces using sealer as recommended by manufacturer.
      - 1) Apply at rate per manufacturer's recommendation.
    - b. Prime and fill new concrete and masonry using sealer coat as recommended by manufacturer followed by modified epoxy filler as specified.
    - c. Prime filled concrete and masonry surfaces with primer at rates and as recommended by manufacturer.
  - 4. Back prime all wood scheduled to be painted, prior to installation.
  - 5. Touch up damaged primer coats prior to applying finish coats.
    - a. Restore primed surface equal to surface before damage.
- D. Finish Coat Application:



1. Apply finish coats in accordance with paint manufacturer's written instructions and in accordance with this Specification Section.
2. Touch up damaged finish coats using same application method and same material specified for finish coat.
  - a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.
3. Hollow metal frames and doors:
  - a. Finish coats shall be spray applied only.
  - b. Finish edges same as faces of doors.
4. Varnish:
  - a. Apply first coat of varnish: Gloss.
    - 1) Allow to dry a minimum of 48 hours.
  - b. Apply second and third coats of varnish: Satin.
    - 1) Allow a minimum of 48 hours between each coat.
  - c. Lightly sand between coats as required and remove dust.

### **3.6 FIELD QUALITY CONTROL**

- A. Application Deficiencies:
  1. Surfaces showing runs, laps, brush marks, telegraphing of surface imperfections or other defects will not be accepted.
  2. Surfaces showing evidence of fading, chalking, blistering, delamination or other defects due to improper surface preparation, environmental controls or application will not be accepted.
- B. Provide protection for painted surfaces.
  1. Surfaces showing soiling, staining, streaking, chipping, scratches, or other defects will not be accepted.
- C. Maintain Daily Records:
  1. Record the following information during application of each coat of paint applied:
    - a. Date, starting time, end time, and all breaks taken by painters.
    - b. For exterior painting:
      - 1) Sky condition.
      - 2) Wind speed and direction.
    - c. Air temperature.
    - d. Relative humidity.
    - e. Moisture content and surface temperature of substrate prior to each coat.
    - f. Provisions utilized to maintain work area within manufacturer's recommended application parameters including temporary heating, ventilation, cooling, dehumidification and provisions utilized to mitigate wind blown dust and debris from contaminating the wet paint film.
    - g. Record environmental conditions, substrate moisture content and surface temperature information not less than once every four (4) hours during application.
      - 1) Record hourly when temperatures are below 50 degrees F or above 100 degrees F.
  2. Record the following information daily for the paint manufacturer's recommended curing period:
    - a. Date and start time of cure period for each item or area.
    - b. For exterior painting:
      - 1) Sky conditions.
      - 2) Wind speed and direction.
    - c. Record environmental conditions not less than once every 12 hours.
      - 1) Record once every 4 hours when ambient temperature is below 35 degrees F.
    - d. Provisions utilized to protect each item or area and to maintain areas within manufacturer's recommended curing parameters.
  3. Format for daily record to be computer generated.

- D. Measure surface temperature of items to be painted with surface temperature gage specifically designed for such.
- E. Measure substrate humidity with humidity gage specifically designed for such.
- F. Provide wet paint signs.

### 3.7 CLEANING

- A. Clean paint spattered surfaces.
  - 1. Use care not to damage finished surfaces.
- B. Remove masking, adhesive residue or other foreign materials.
- C. Upon completion of painting, replace hardware, accessories, plates, fixtures, and similar items.
- D. Remove surplus materials, scaffolding, and debris.

### 3.8 COLOR SCHEDULE

Color Tag	Manufacturer	Color Number	Color Name	Sheen
AP-1	PPG	PPG14-26	Hideaway	Eggshell
AP-2	PPG	PPG1014-1	Glacial Ice	Semi-Gloss
SC-1	Zolatone			N/A
SC-2	Zolatone			N/A
ST-1	PPG Olympic			N/A
ST-2	PPG Olympic			N/A

**END OF SECTION**

**SECTION 09 96 00**  
**HIGH PERFORMANCE INDUSTRIAL COATINGS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. High performance industrial coatings (HPIC).
  - 2. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.
  - 3. Minimum surface preparation requirements.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 01 61 03 - Equipment - Basic Requirements.
  - 2. Section 09 91 10 - Architectural Painting.
  - 3. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC).
  - 4. Division 26 - Electrical.
  - 5. Division 40 - Process Interconnections.
  - 6. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. B499, Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals.
    - b. D3359, Standard Test Methods for Rating Adhesion by Tape Test.
    - c. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
    - d. D4259, Standard Practice for Abrading Concrete.
    - e. D4261, Standard Practice for Surface Cleaning Concrete Masonry Units for Coating.
    - f. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
    - g. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
    - h. D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
    - i. D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
    - j. D6132, Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage.
    - k. D6677, Standard Test Method for Evaluating Adhesion by Knife.
    - l. D7091, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
    - m. D7234, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
    - n. E337, Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).
    - o. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
    - p. F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
  - 2. Environmental Protection Agency (EPA).
  - 3. International Concrete Repair Institute (ICRI):

- a. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- 4. NACE International (NACE).
- 5. National Association of Pipe Fabricators (NAPF):
  - a. 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings:
    - 1) 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe.
    - 2) 500-03-05, Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
- 6. NSF International (NSF).
  - a. 61, Drinking Water System Components - Health Effects.
- 7. The Society for Protective Coatings (SSPC):
  - a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
  - b. SP 1, Solvent Cleaning.
  - c. SP 2, Hand Tool Cleaning.
  - d. SP 3, Power Tool Cleaning.
  - e. SP 16, Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
- 8. The Society for Protective Coatings/ NACE International (SSPC/ NACE):
  - a. SP 5/ NACE No. 1, White Metal Blast Cleaning
  - b. SP 6/ NACE No. 3, Commercial Blast Cleaning.
  - c. SP 7/ NACE No. 4, Brush-off Blast Cleaning.
  - d. SP 10/ NACE No. 2, Near-White Blast Cleaning.
  - e. SP 13/ NACE No. 6, Surface Preparation of Concrete.
- B. Qualifications:
  - 1. Coating manufacturer's technical representative shall be a NACE Certified Coatings Inspector, Level 3 minimum.
  - 2. Applicators shall have minimum of 10 years of experience in application of similar products on similar project.
    - a. Provide references for minimum of three different projects completed in last five years with similar scope of work.
    - b. Include name and address of project, size of project in value (coating) and contact person.
  - 3. NACE inspector shall be NACE Certified Coatings Inspector Level 3 minimum and shall have minimum of five years of experience of conducting inspections and tests as indicated in this Specification Section.
- C. Miscellaneous:
  - 1. Furnish coating through one manufacturer unless noted otherwise.
- D. Deviation from specified MIL thickness or product type is not allowed without written authorization of Engineer.
- E. Material shall not be thinned unless approved, in writing, by coating manufacturer's technical representative.

### 1.3 DEFINITIONS

- A. Applicator:
  - 1. Applicator is the person actually installing or applying the product in the field, at the Project site, or at an approved shop facility.
- B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified or in Specification Section 01 61 03.
- C. Appurtenant Surface: Accessory or auxiliary surface attached to or adjacent to a surface indicated to be coated.

- D. Corrosive Environment:
  - 1. Immersion in or subject to:
    - a. Condensation, spillage or splash of a corrosive material such as water, wastewater or chemical solution.
    - b. Exposure to corrosive caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions.
    - c. For purposes of this Specification Section, corrosive environments include:
      - 1) Outdoor areas not otherwise identified as highly corrosive.
      - 2) Piping galleries.
      - 3) Surfaces within 2 feet of high water level.
      - 4) Chemicals storage and feed areas:
- E. Outdoor Atmosphere or Surface: Outdoor atmosphere or surface exposed to weather and/or direct sunlight.
- F. Finished Area: A room or area that is listed in or has finish called for on Room Finish Schedule or is indicated on Drawings to be coated.
- G. Holiday:
  - 1. A void, crack, thin spot, foreign inclusion, or contamination in the coating that significantly lowers the dielectric strength of the coating.
  - 2. May also be identified as a discontinuity or pinhole.
- H. HPIC: High performance industrial coatings.
  - 1. Epoxies, urethanes, vinyl ester, waterborne vinyl acrylic emulsions, acrylates, silicones, alkyds, acrylic emulsions and any other coating listed as a HPIC.
- I. Indoor Atmosphere or Surface: Indoor atmosphere or surface not exposed to weather and/or direct sunlight.
- J. Immersion Service:
  - 1. Any surface immersed in water or some other liquid.
  - 2. Surface of any pipe, valve, or any other component of the piping system subject to frequent wetting.
  - 3. Surfaces within two feet above high water level in water bearing structures.
- K. Piping System: Pipe, valves, fittings and accessories.
- L. Surface Hidden from View:
  - 1. Within pipe chases.
  - 2. Between top side of ceilings and underside of floor or roof structures above.
- M. Vapor Space: Interior space within tankage, closed structures, or similar elements that is above the low liquid line and subject to the accumulation of fumes, vapor and/or condensation.

#### **1.4 SUBMITTALS**

- A. Certifications:
  - 1. Applicator experience qualifications.
    - a. No submittal information will be reviewed until Engineer has received and approved applicator qualifications.
  - 2. NACE inspector certification.
  - 3. NACE inspector experience qualifications.
  - 4. Certification that High Performance Coating Systems proposed for use have been reviewed and approved by a NACE Certified Coatings Inspector employed by the coating manufacturer.
    - a. Submittals not including this certification will be returned without review.
- B. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.

- b. Manufacturer's surface preparation instructions.
  - c. Manufacturer's application instructions.
    - 1) Manufacturer's standard details, including but not limited to penetrations, transitions, and terminations for:
      - a) High-build coatings on concrete.
      - b) Secondary containment coatings.
      - c) UV channels.
      - d) Other special conditions as applicable.
  - d. If products being used are manufactured by Company other than listed in the MATERIALS Article of this Specification Section, provide complete individual data sheet comparison of proposed products with specified products including:
    - 1) Application procedure.
    - 2) Coverage rates.
    - 3) Certification that product is designed for intended use and is equal or superior to specified product.
  - e. Contractor's written plan of action for containing airborne particles created by blasting operation and location of disposal of spent contaminated blasting media.
  - f. Coating manufacturer's recommendation on abrasive blasting.
  - g. Coating manufacturer's technical representative's written statement attesting that applicator has been instructed on proper preparation, mixing and application procedures for coatings specified.
  - h. Manufacturer's recommendation for universal barrier coat.
  - i. Manufacturer's recommendation for providing temporary or supplemental heat or dehumidification or other environmental control measures.
2. Manufacturer's statement regarding applicator instruction on product use.
- C. Samples:
- 1. Manufacturer's full line of colors for Engineer's preliminary color selection.
  - 2. After preliminary color selection by Engineer provide two, 3 x 5 inches samples of each final color selected.
- D. Informational Submittals:
- 1. Approval of application equipment.
  - 2. Applicator's daily records:
    - a. Submit daily records at end of each week in which coating work is performed unless requested otherwise by Engineer's on-site representative.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver in original containers, labeled as follows:
  - 1. Name or type number of material.
  - 2. Manufacturer's name and item stock number.
  - 3. Contents, by volume, of major constituents.
  - 4. Warning labels.
  - 5. VOC content.
- B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.

## **1.6 PROJECT CONDITIONS**

- A. Pre-application Conference:
  - 1. Prior to commencement of surface preparation or coating application, the Contractor shall convene a pre-application conference with all affected parties, including but not limited to: the applicator, coating manufacturer's technical representative, Owner's representative, and Engineer's representative(s).
  - 2. The meeting shall discuss all aspects of the Project including but not limited to:
    - a. Schedule.

- b. Material storage and handling.
  - c. Examination of surfaces to be coated.
  - d. Protection of surfaces not to be coated.
  - e. Surface preparation.
  - f. Coating application:
    - 1) Environmental conditions for application of coatings.
    - 2) Temporary environmental controls.
  - g. Field quality control requirements:
    - 1) Manufacturer's technical representative responsibilities.
    - 2) Contractor performed testing.
      - a) Instrumentation requirements.
      - b) Frequency of testing.
      - c) Record keeping.
    - 3) NACE inspector performed testing.
- B. Verify that atmosphere in area where coating is to take place is within coating manufacturer's acceptable temperature, humidity and sun exposure limits.
- 1. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
    - a. Provide temporary dehumidification equipment properly sized to maintain humidity levels required by coating manufacturer.
    - b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 hour basis.
      - 1) Vent exhaust gases to outdoor environment.
      - 2) No exhaust gases shall be allowed to vent into the space being coated or any adjacent space.
  - 2. Do not apply coatings in snow, rain, fog or mist.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 1. High Performance Industrial Coatings:
    - a. Carboline Protective Coatings.
    - b. PPG.
    - c. The Sherwin-Williams Company.
    - d. Tnemec.
    - e. AkzoNobel.
- B. "Or-Equal" Submittals:
- 1. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the manufacturers listed.
  - 2. Provide satisfactory documentation from the proposed "or-equal" manufacturer that proposed materials meet or exceed the following:
    - a. Is of the same generic resin.
    - b. Requires comparable surface preparation.
    - c. Has comparable application requirements.
    - d. Meets the same VOC levels or better.
    - e. Provides the same finish and color options.
    - f. Is suitable for the intended service.
    - g. Resistance to abrasion and physical damage.
    - h. Resistance to chemical attack.
    - i. Resistance to UV exposure.
    - j. Ability to recoat in future.

- k. Dry film thickness per coat.
    - 1) Where manufacturer's product data sheet indicates a minimum MIL thickness per coat that is greater than specified herein, MIL thickness for entire coating system shall be increased proportionately.
  - l. Minimum and Maximum time between coats.
  - m. Compatibility with other coatings.
  - n. Temperature limitations in service and during application.
  - o. Type and quality of recommended undercoats and topcoats.
  - p. Ease of application.
  - q. Ease of repairing damaged areas.
  - r. Stability of colors.
3. The cost of all testing and analyzing of the proposed substitute materials shall be borne by the CONTRACTOR.

## 2.2 MATERIALS

a.

B. Coatings shall comply with the VOC limits of EPA:

C. For unspecified materials such as thinner, provide manufacturer's recommended products.

D. High Performance Industrial Coatings:

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
AAE	Acrylic/Acrylate Emulsion	Series 180 WB Tneme-Crete	Cement Plex 875
ARE	Abrasion-Resistant Epoxy	Series 435 Perma-Glaze	Duraplate 6000
AREC	Abrasion-Resistant Epoxy Coating	Series 435 Perma-Glaze	Duraplate 5900
AAP	Aliphatic Acrylic Polyurethane	Series 1095 Endurashield	Acrolon Ultra
AP	Acrylic Polymer	Series 1029 Enduratone	Pro Industrial Acrylic Coating
CRM	Cementitious Repair Mortar	Series 217 MortarCrete	Cemtec Silatec MSM
CRU	Corrosion Resistant Urethane	Series 290 CRU	Polylon HP
DFA	Dry-fall Acrylic	Series 115 Uni-Bond DF	DFA Dry Fall Acrylic
EBF	Epoxy Block Filler	Series 1254 Epoxoblock WB	Kem Cati Coat HS
ESF	Epoxy Surfacer/Filler	Series 215 Surfacing Epoxy	Steel Seam FT 910
EMM	Epoxy Modified Cementitious Mortar	Series 218 MortarClad	Duraplate 2300
EF	Epoxy Flooring	Series 237 Power-Tread	GP3746
GFRE	Glass Flake Reinforced Epoxy	Series 142	Sher-Glass FF



COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
HRE Not SCAQMD Compliant	H2S-Resistant Epoxy	Series 132 Protuff Mastic	Duraplate 235
HRE SCAQMD Compliant	H2S-Resistant Epoxy	Series 435 Perma-Glaze	Duraplate 6000
HREM	H2S-Resistant Epoxy Mortar	Series 434 Perma-Shield H <sub>2</sub> S	Duraplate 5900 Mortar
MIO	MIO Polyurethane	Series 1 Omnithane	Corothane 1 milesO
MPE	Multi-Purpose Epoxy	Series N69 Hi-Build Epoxoline II	Macropoxy 646
MPE	Multi-Purpose Epoxy	Series L69 Hi-Build Epoxoline II	Macropoxy 646-100
MTEP	Moisture-Tolerant Epoxy Primer	Series 201 Epoxoprime	Corobond 100
NSFE	NSF Epoxy (NSF 61)	Series N140 Pota-Pox Plus	Macropoxy 646 PW
NSFE	NSF Epoxy (NSF 61)	Series L140 Pota-Pox Plus	Macropoxy 5500
REC	Reinforced Epoxy Coating	Series 436 Perma-Shield FR	Duraplate 6000
PVA	PVA Drywall Primer	Series 51 PVA Sealer	ProMar 200 Zero VOC Interior Latex Primer
SCN	Secondary Containment Novolac	Series 282	Cor Cote HCR
SCE	Secondary Containment Epoxy	Series 237SC Chembloc	Cor Cote HP
SCEP	Secondary Containment Epoxy Primer	Series 206SC Chembloc	GP3552
STEP	Surface-Tolerant Epoxy Primer	Series 135 Chembuild	Macropoxy 646
UHSE	Ultra-High Solids Epoxy (NSF 61)	Series 22 Epoxoline	Duraplate UHS
VEP	Vinyl Ester Primer	Series 251SC Chembloc	Corobond Vinyl Ester Primer
VESC	Vinyl Ester Secondary Containment	Series 252SC Chembloc	Cor Cote VEN FF
PVA	PVA Drywall Primer	Series 51 PVA Sealer	ProMar 200 Zero VOC Interior Latex Primer
SCN	Secondary Containment Novolac	Series 282	Cor Cote HCR
ZRU	Zinc-Rich Urethane	Series 94-H <sub>2</sub> O Hydro-Zinc	Corothane 1 Galvapak

### 2.3 COATING SYSTEMS:

A. The following tables indicate coating systems by material and environment unless a specific application is indicated.

B. Ferrous Metals (Structural and Miscellaneous Metals):

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Immersion - Wastewater	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 mil MPE		12 to 16 mil GFRE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 10/ NACE No. 2 min. 3 mil anchor profile	15 to 20 mil AREC		15 to 20 mil AREC
Immersion - non NSF	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Immersion - NSF	SSPC-SP / NACE No.1	4.0 to 5.0 mil NSFE	4.0 to 5.0 mil NSFE	4.0 to 5.0 mil NSFE
Outdoor atmospheric	SSPC-SP 6/ NACE No. 3	2.5 to 3.5 mil ZRU	3.0 to 5.0 mil MPE	2.5 to 3.5 mil AAP
Vapor space at covered clarifiers, digesters and similar structures	SSPC-SP 10/ NACE No. 2 min. 3 mil anchor profile	5 to 7 mil HRE		30 to 40 mil AREC
Hollow Metal Doors	SSPC-SP 3	2.5 to 3.5 mil STEP		2.5 to 3.5 mil AAP
Bar Joists Indoor atmospheric	SSPC SP-3 SSPC Rust Grade Condition C			2.0 TO 3.5 mil DFA
Bar Joists (corrosive environment)	SSPC SP-3 SSPC Rust Grade Condition C	2.5 to 3.5 mil MIO		3.0 to 4.0 mil MPE

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Factory Primed Metal Deck Indoor atmospheric	SSPC SP-3 SSPC Rust Grade Condition C			2.0 TO 3.5 mil DFA
Factory Primed Metal Deck (corrosive environment)	SSPC SP-3 SSPC Rust Grade Condition C	4.0 to 6.0 mil STEP		2.0 to 3.0 mil MPE
Thermal Break Coating	SSPC-SP 6/ NACE No. 3	2.5 to 3.5 mil ZRP	Two coats AIC at 40 to 50 mil per coat	2.0 to 3.0 mil AP

C. Ferrous Piping:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Vapor space at covered clarifiers, digesters and similar structures	SSPC-SP 10/ NACE No. 2 min. 3 mil anchor profile	5 to 7 mil HRE		30 to 40 mil AREC
Immersion - Wastewater	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 mil HRE		12 to 16 mil GFRE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 10/ NACE No. 2, min 3 mil anchor profile	15 to 20 mil AREC		15 to 20 mil AREC
Immersion - non NSF	SSPC-SP 5/ NACE No.1	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Immersion - NSF	SSPC-SP 5/ NACE No.1	4.0 to 5.0 mil MPE	4.0 to 5.0 mil MPE	4.0 to 5.0 mil MPE
Outdoor atmospheric	SSPC-SP 10/ NACE No. 2	2.5 to 3.5 mil ZRU	3.0 to 4.0 mil MPE	2.5 to 3.5 mil AAP

D. Ductile Iron Piping:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Vapor space at covered clarifiers, digesters and similar structures	SSPC-SP 10/ NACE No. 2 min. 3 mil anchor profile	5 to 7 mil HRE		30 to 40 mil AREC
Immersion - Wastewater	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil HRE		12 to 16 mil GFRE
Immersion - Wastewater (abrasion resistant)	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	15 to 20 mil AREC		15 to 20 mil AREC
Immersion - non NSF	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Outdoor atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	2.5 to 3.5 mil AAP

## PART 3 - EXECUTION

### 3.1 ITEMS TO BE COATED

- A. Outdoor Surfaces, including but not limited to:
  - 1. Piping, valves, fittings, hydrants and supports:
    - a. As scheduled in Specification Section 40 05 00.
  - 2. Ferrous metal tankage.
  - 3. Ferrous metal process equipment.
    - a. Clarifier mechanisms.
    - b. Equipment bridges.
    - c. Gates and operators.
  - 4. Structural steel:
    - a. Columns, beams and bracing.
    - b. Steel joists or trusses, including bridging.
    - c. Field welded connections of factory coated structural steel.
  - 5. Miscellaneous ferrous metal surfaces:
    - a. Items specifically noted on Drawings to be coated.

6. Appurtenant surfaces attached to or adjacent to a surface indicated to be coated:
  - a. Conduit, boxes, covers and supports.

### **3.2 ITEMS NOT TO BE COATED**

- A. General: Do not coat items listed in this Article, unless noted otherwise.
- B. Items with Approved Factory Finish: These items may require repair of damaged coated areas or coating of welded connections.
- C. Electrical Equipment.
- D. Moving parts of mechanical and electrical units where coating would interfere with the operation of the unit.
- E. Code labels, equipment identification or rating plates and similar labels, tagging and identification.
- F. Contact surfaces of friction-type structural connections.
- G. Stainless Steel Surfaces, except:
  1. Dissimilar metals in immersion service.
  2. Piping where specifically noted to be coated.
  3. Banding as required to identify piping.
- H. Aluminum Surfaces, except:
  1. Where specifically shown in the Contract Documents.
  2. Where in contact with concrete.
  3. Where in contact with dissimilar metals.
  4. Appurtenant surfaces as described in the ITEMS TO BE COATED article.
- I. Fiberglass Surfaces, except:
  1. Fiberglass piping where specifically noted to be coated.
  2. Piping supports where specifically noted to be coated.
  3. Appurtenant surfaces as described in the ITEMS TO BE COATED article.
- J. Mechanical piping scheduled to be insulated.
- K. Interior of Pipe, Ductwork, and Conduits.
  1. See Division 23 for ductwork.
  2. See Division 40 for pipe linings.
- L. Galvanized Steel Items, unless specifically noted to be coated.
- M. Architectural Finishes:
  1. Outdoor concrete indicated to receive another finish.
  2. Precast concrete surfaces, unless specifically indicated to be coated.
  3. Prefinished masonry surfaces:
    - a. Pre-colored masonry (outdoor face).
      - 1) Interior face shall be coated where scheduled.
    - b. Burnished (ground face) concrete masonry.
    - c. Prefaced masonry.
    - d. Face brick.
    - e. Glass masonry.
  4. Plastic laminate.
  5. Solid surface material.
  6. Standing and running trim.
  7. Fiberglass fabrications.
  8. Anodized aluminum.
  9. PVDF coated metals.
  10. Factory finished doors and frames.
  11. Aluminum windows, curtainwall and storefront framing systems.

12. Finish hardware.
13. Glass and glazing.
14. Ceramic, porcelain, quarry tile or natural stone.
15. Acoustical materials.
16. Building specialties.
17. Louvers.
18. Casework and countertops.
19. Pipe insulation and jacketing.
20. Standing seam metal roof, fascia, trim, soffit and accessories.

### 3.3 EXAMINATION

- A. Concrete:
  1. Test pH of surface to be coated in accordance with ASTM D4262.
    - a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable range.
    - b. Retest pH until acceptable results are obtained.
  2. Verify that moisture content of surface to be coated is within coating manufacturer's recommended acceptable limits.
    - a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
      - 1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869 or ASTM F2170.
      - 2) Provide remedial measures as necessary to bring moisture content within coating manufacturer's recommended acceptable limits.
      - 3) Retest surface until acceptable results are obtained.
- B. Concrete Unit Masonry:
  1. Test pH of surface to be coated in accordance with ASTM D4262.
    - a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable limits.
    - b. Retest pH until acceptable results are obtained.
  2. Verify that moisture content of surface to be coated is within coating manufacturer's recommended acceptable limits.
    - a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
      - 1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869.
      - 2) Provide remedial measures as necessary to bring moisture content within coating manufacturer's recommended acceptable limits.
      - 3) Retest surface until acceptable results are obtained.

### 3.4 PREPARATION

- A. General:
  1. Prepare surfaces to be coated in accordance with coating manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.
    - a. Where discrepancy between coating manufacturer's instructions and this Specification Section exists, the more stringent surface preparation shall be provided unless approved otherwise, in writing, by the Engineer.
  2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of coating to surface.
  3. Adhere to manufacturer's recoat time surface preparation requirements.

- a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
      - 1) Minimum SSPC-SP 7/ NACE No. 4 unless otherwise approved by Engineer.
- B. Protection:
  1. Protect surrounding surfaces not to be coated.
  2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
  3. Protect code labels, equipment identification or rating plates and similar labels, tagging and identification.
- C. Prepare and coat before assembly all surfaces which are inaccessible after assembly.
- D. Ferrous Metal:
  1. Prepare ductile iron pipe in accordance with pipe manufacturer's recommendations and NAPF.
    - a. All piping, pumps, valves, fittings and any other component used in the water piping system that requires preparation for coating shall be prepared in accordance with requirements for immersion service.
    - b. Prepare all areas requiring patch coating in accordance with recommendations of manufacturer and NAPF.
    - c. Remove bituminous coating per piping manufacturer, coating manufacturer and NAPF recommendations.
      - 1) The most stringent recommendations shall apply.
  2. Complete fabrication, welding or burning before beginning surface preparation.
    - a. Chip or grind off flux, spatter, slag or other laminations left from welding.
    - b. Remove mill scale.
    - c. Grind smooth rough welds and other sharp projections.
  3. Solvent clean in accordance with SSPC-SP 1.
  4. Restore surface of field welds and adjacent areas to original surface preparation.
- E. Galvanized Steel and Non-ferrous Metals:
  1. Solvent clean in accordance with SSPC-SP 1 followed by brush-off blast clean in accordance with SSPC-SP 16 to remove zinc oxide and other foreign contaminants.
    - a. Provide uniform 1 mil profile surface.
- F. Concrete:
  1. Cure for minimum of 28 days.
  2. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
  3. Abrasive blast concrete surfaces in accordance with ASTM D4259 and SSPC-SP 13/ NACE No. 6.
    - a. Provide profile per ICRI 301.2 as listed in MATERIALS article of this Specification Section.
  4. Test pH and moisture content in accordance with EXAMINATION article in this Specification Section.
- G. Concrete Masonry:
  1. Cure for minimum of 28 days.
  2. Remove all mortar spatters and protrusions.
  3. Clean concrete masonry in accordance with Specification ASTM D4261.
  4. Test pH and moisture content in accordance with EXAMINATION article in this Specification Section.
- H. Preparation by Abrasive Blasting:
  1. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting and before coating.
  2. Provide compressed air for blasting that is free of water and oil.

- a. Provide accessible separators and traps.
  3. Protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from blasting.
  4. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of coatings.
    - a. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
  5. Perform additional blasting and cleaning as required to achieve surface preparation required.
    - a. Re-blast surfaces not meeting requirements of these Specifications.
    - b. Prior to coating, re-blast surfaces allowed to set overnight and surfaces that show rust bloom.
    - c. Surfaces allowed to set overnight or surfaces which show rust bloom prior to coating shall be re-inspected prior to coating application.
  6. Profile depth of blasted surface: Not less than 1 mil or greater than 2 mils unless required otherwise by coating manufacturer.
  7. Ensure abrasive blasting operation does not result in embedment of abrasive particles in coating.
  8. Confine blast abrasives to area being blasted.
    - a. Provide shields of polyethylene sheeting or other such barriers to confine blast material.
    - b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
  9. Abrasive blasting media may be recovered, cleaned and reused providing Contractor submits, for Engineer's review, a comprehensive recovery plan outlining all procedures and equipment proposed in reclamation process.
  10. Properly dispose of blasting material contaminated with debris from blasting operation.
- I. All Plastic Surfaces:
1. Sand using 80-100 grit sandpaper to scarify surfaces.

### **3.5 APPLICATION**

- A. General:
1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
    - a. Application equipment must be inspected and approved in writing by coating manufacturer.
  2. Temperature and weather conditions:
    - a. Do not coat surfaces when surface temperature is below 50 degrees F unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and coating manufacturer's technical representative.
    - b. Avoid coating surfaces exposed to hot sun.
    - c. Do not coat damp surfaces.
    - d. Apply coating to concrete or masonry surfaces in descending temperatures, in accordance with coating manufacturer's application instructions.
  3. Apply materials under adequate illumination.
  4. Provide complete coverage to MIL thickness specified.
    - a. Thickness specified is dry MIL thickness.
  5. Evenly spread to provide full, smooth coverage.
    - a. All coating systems are "to cover."
      - 1) In situations of discrepancy between manufacturer's square footage coverage rates and MIL thickness, MIL thickness requirements govern.
    - b. When color or undercoats show through, apply additional coats until coating is of uniform finish and color.
    - c. Finished coating system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.



6. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
  7. Work each application of material into corners, crevices, joints, and other difficult to work areas.
  8. Provide coating manufacturer's recommended details at all terminations, penetrations, embedments, cracks, joints and changes in substrate direction.
  9. Avoid degradation and contamination of blasted surfaces and avoid inter-coat contamination.
    - a. Clean contaminated surfaces before applying next coat.
    - b. Intercoat surface cleanliness shall be inspected and approved by the Engineer prior to application of each coat.
  10. Smooth out runs or sags immediately, or remove and recoat entire surface.
  11. Allow preceding coats to dry before recoating.
    - a. Recoat within time limits specified by coating manufacturer.
    - b. If recoat time limits have expired re-prepare surface in accordance with coating manufacturer's printed recommendations.
  12. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
  13. Coat all aluminum in contact with dissimilar materials.
  14. When coating rough surfaces which cannot be backrolled sufficiently, hand brush coating to work into all recesses provided that the maximum DFT is not exceeded.
  15. Backroll surfaces if coatings are spray applied.
- B. Employ services of coating manufacturer's technical representative to ensure that field-applied coatings are compatible with factory-applied or existing coatings.
1. Certify through material data sheets.
  2. Perform test patch.
    - a. Prepare existing coating surface to receive specified coating system.
    - b. Apply coating to a minimum 1 square feet area and allow to cure in accordance with manufacturer's recommendations.
    - c. Evaluate adhesion to existing coating:
      - 1) Concrete or Masonry substrates: ASTM D4541.
      - 2) All other substrates: ASTM D6677 and ASTM D3359 (X-cut method).
  3. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.
    - a. Perform test patch as described above.
  4. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using appropriate coating system listed in the MATERIALS Article, Coating Systems paragraph of this Specification Section.
    - a. All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.
- C. Prime Coat Application:
1. Apply structural steel and miscellaneous steel prime coat in the factory.
    - a. Finish coats shall be applied in the field or factory.
    - b. Prime coat referred to here is prime coat as indicated in this Specification.
      - 1) Prime coating applied in factory (shop) as part of Fabricator's standard rust inhibiting and protection coating is not acceptable as replacement for specified prime coating.
    - c. Application of all factory-applied coatings(s) on structural steel and miscellaneous steel and steel truss shall be continually observed and certified by NACE coatings inspector.
  2. Prime all surfaces indicated to be coated.
    - a. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Specification Section.
  3. Prime ferrous metals embedded in concrete to minimum of 1 inch below exposed surfaces.
  4. Apply zinc-rich primers while under continuous agitation.

5. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over entire surface.
  6. Touch up damaged primer coats prior to applying finish coats.
    - a. Restore primed surface equal to surface before damage.
  7. All surfaces of steel lintels and steel components of concrete lintels used in wall construction shall be completely coated with both prime and finish coats prior to placing in wall.
- D. Finish Coat Application:
1. Apply finish coats in accordance with coating manufacturer's written instructions and in accordance with this Specification Section; manufacturer instructions take precedent over these Specifications.
  2. Touch up damaged finish coats using same application method and same material specified for finish coat.
    - a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.

### **3.6 COLOR CODING**

- A. Color code piping in accordance with the SCHEDULE Article of this Specification Section.

### **3.7 FIELD QUALITY CONTROL**

- A. Application Deficiencies:
1. Surfaces showing runs, laps, brush marks, telegraphing of surface imperfections or other defects will not be accepted.
  2. Surfaces showing evidence of fading, chalking, blistering, delamination or other defects due to improper surface preparation, environmental controls or application will not be accepted.
    - a. Epoxy surfaces showing evidence of chalking or amine blush shall be prepared and recoated as follows:
      - 1) Solvent clean surfaces in accordance with SSPC-SP1 and abrasive blast in accordance with SSPC-SP7/ NACE No. 4.
      - 2) Recoat with intermediate and finish coats in accordance with coating system specified herein.
- B. Provide protection for coated surfaces.
1. Surfaces showing soiling, staining, streaking, chipping, scratches, or other defects will not be accepted.
- C. Contractor Performed Testing:
1. Provide ongoing testing and inspection, including but not limited to the following:
    - a. Measurement and recording of environmental conditions as specified herein.
    - b. Measurement and recording of substrate conditions as specified herein.
    - c. Thickness Testing:
      - 1) Wet film thickness during application in accordance with ASTM D4414.
      - 2) Dry Film Thickness (DFT) in accordance with SSPC-PA 2.
      - 3) Engineer may measure coating thickness at any time during project to assure conformance with these Specifications.
- D. NACE inspection:
1. The Owner reserves the right to retain a NACE Level 3 coating inspector to perform observation, inspection and testing as deemed necessary to document the quality of the Work.
    - a. All work shall be done to the satisfaction of the Owner's inspector.
    - b. Any portion of the coating that does not satisfactorily pass the inspection and testing requirements shall be repaired or replaced by the Contractor at no additional cost to the Owner.
    - c. Additional testing and/or inspection may be done at the discretion of the Owner.

- 1) The Contractor will provide all equipment, materials, and labor to perform the testing.
  2. Inspection, testing or observation by the Owner's inspector shall not relieve the Contractor of responsibility for surface preparation, inspection or quality control specified herein.
- E. Instrumentation:
1. Provide instrumentation as necessary to measure and record atmospheric and substrate conditions, including but not limited to:
    - a. Dry Film Thickness Gauge:
      - 1) Ultrasonic: ASTM D6132.
      - 2) Magnetic: ASTM B499.
    - b. Wet Film Thickness Gauge: ASTM D4414.
    - c. Sling Psychrometer: ASTM E337.
    - d. Surface Temperature Gauge.
    - e. Anemometer.
    - f. Moisture Meter.
    - g. Adhesion test apparatus:
      - 1) Steel: ASTM D4541.
      - 2) Concrete: ASTM D7234.
- F. Maintain Daily Records:
1. Record the following information during application:
    - a. Date, starting time, end time, and all breaks taken by applicators.
    - b. Air temperature.
    - c. Relative humidity.
    - d. Dew point.
    - e. Moisture content and pH level of concrete or masonry substrates prior to coating.
    - f. Surface temperature of substrate.
    - g. Provisions utilized to maintain work area within manufacturer's recommended application parameters including temporary heating, ventilation, cooling, dehumidification and provisions utilized to mitigate wind-blown dust and debris from contaminating the wet coating.
    - h. For outdoor coating, also record:
      - 1) Sky condition.
      - 2) Wind speed and direction.
    - i. Record environmental conditions, substrate moisture content and surface temperature information not less than once every 4 hours during application.
      - 1) Record hourly when temperatures are below 50 degrees F or above 100 degrees F.
  2. Record the following information daily for the coating manufacturer's recommended curing period:
    - a. Date and start time of cure period for each item or area.
    - b. For outdoor coating, also record:
      - 1) Sky conditions.
      - 2) Wind speed and direction.
      - 3) Air temperature.
        - a) Dry Bulb.
        - b) Wet Bulb.
      - 4) Relative humidity.
      - 5) Dew point.
      - 6) Surface temperatures.
    - c. Record environmental conditions not less than once every 4 hours.
      - 1) Record hourly when temperatures are below 50 degrees F or above 100 degrees F.
    - d. Provisions utilized to protect each item or area and to maintain areas within manufacturer's recommended curing parameters.
  3. Format for daily record to be computer generated.

G. Provide wet paint signs.

### **3.8 CLEANING**

A. Clean coating spattered surfaces.

1. Use care not to damage finished surfaces.

B. Upon completion of coating, replace hardware, accessories, plates, fixtures, and similar items.

C. Remove surplus materials, scaffolding, and debris.

### **3.9 COLOR SCHEDULE**

A. Pipe Bollards: Safety Yellow.

**END OF SECTION**



**DIVISION 10**

**SPECIALTIES**



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## **SECTION 10 14 00**

### **IDENTIFICATION DEVICES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Tag, tape and stenciling systems for equipment, piping, valves, pumps, ductwork and similar items.
  - 2. Hazard and safety signs.
- B. Related Specification Sections include but are not necessarily limited to:

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. A13.1, Scheme for the Identification of Piping Systems.
  - 2. The International Society of Automation (ISA).
  - 3. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
    - a. Z535.1, Safety Color Code.
    - b. Z535.2, Environmental and Facility Safety Signs.
    - c. Z535.3, Criteria for Safety Symbols.
    - d. Z535.4, Product Safety Signs and Labels.
  - 4. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
    - b. 704, Standard System for the Identification of Hazards of Materials for Emergency Response.
  - 5. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910.145, Specification for Accident Prevention Signs and Tags.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Catalog information for all identification systems.
    - b. Acknowledgement that products submitted meet requirements of standards referenced.
  - 2. Identification register, listing all items in PART 3 of this Specification Section to be identified, type of identification system to be used, lettering, location and color.
  - 3. Schedule of Hazard and Safety Signage indicating text and graphics.

#### **PART 2 - PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. W.H. Brady Co.
  - 2. Panduit.
  - 3. Seton.
  - 4. National Band and Tag Co.
  - 5. Carlton Industries, Inc.

## 2.2 MANUFACTURED UNITS

- A. Type A1 - Round Metal Tags:
  - 1. Materials:
    - a. Aluminum or stainless steel.
    - b. Stainless steel shall be used in corrosive environments.
  - 2. Size:
    - a. Diameter: 1-1/2 inches minimum.
    - b. Thickness: 0.035 inches (20 GA) minimum.
  - 3. Fabrication:
    - a. 3/16 inches minimum mounting hole.
    - b. Legend: Stamped and filled with black coloring.
  - 4. Color: Natural.
- B. Type A2 - Rectangle Metal Tags:
  - 1. Materials: Stainless steel.
  - 2. Size:
    - a. 3-1/2 inches x 1-1/2 inches minimum.
    - b. Thickness: 0.036 inches (20 GA) minimum.
  - 3. Fabrication:
    - a. 3/16 inches minimum mounting hole.
    - b. Legend: Stamped and filled with black coloring.
  - 4. Color: Natural.
- C. Type A3 - Metal Tape Tags:
  - 1. Materials: Aluminum or stainless steel.
  - 2. Size:
    - a. Width 1/2 inches minimum.
    - b. Length as required by text.
  - 3. Fabrication:
    - a. 3/16 inches minimum mounting hole.
    - b. Legend: Embossed.
  - 4. Color: Natural.
- D. Type B1- Square Nonmetallic Tags:
  - 1. Materials: Fiberglass reinforced plastic.
  - 2. Size:
    - a. Surface: 2 x 2 inches minimum.
    - b. Thickness: 100 mils.
  - 3. Fabrication:
    - a. 3/16 inches mounting hole with metal eyelet.
    - b. Legend: Preprinted and permanently embedded and fade resistant.
  - 4. Color:
    - a. Background: Manufacturer standard or as specified.
    - b. Lettering: Black.
- E. Type B2 - Nonmetallic Signs:
  - 1. Materials: Fiberglass reinforced or durable plastic.
  - 2. Size:
    - a. Surface: As required by text.
    - b. Thickness: 60 mils minimum.
  - 3. Fabrication:
    - a. Rounded corners.
    - b. Drilled holes in corners with grommets.
    - c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.
  - 4. Color:



- a. Background: Manufacturer standard or as specified.
  - b. Lettering: Black.
- 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- F. Type C - Laminated Name Plates:
  - 1. Materials: Phenolic or DR (high impact) acrylic.
  - 2. Size:
    - a. Surface: As required by text.
    - b. Thickness: 1/16 inches.
  - 3. Fabrication:
    - a. Outdoor rated and UV resistant when installed outdoors.
    - b. Two layers laminated.
    - c. Legend: Engraved through top lamination into bottom lamination.
    - d. Two drilled side holes, for screw mounting.
  - 4. Color: Black top surface, white core, unless otherwise indicated.
- G. Type D - Self-Adhesive Tape Tags and Signs:
  - 1. Materials: Vinyl tape or vinyl cloth.
  - 2. Size:
    - a. Surface: As required by text.
    - b. Thickness: 5 mils minimum.
  - 3. Fabrication:
    - a. Indoor/Outdoor grade.
    - b. Weather and UV resistant inks.
    - c. Permanent adhesive.
    - d. Legend: Preprinted.
    - e. Wire markers to be self-laminating.
  - 4. Color: White with black lettering or as specified.
  - 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- H. Type E - Heat Shrinkable Tape Tags:
  - 1. Materials: Polyolefin.
  - 2. Size: As required by text.
  - 3. Fabrication:
    - a. Legend: Preprinted.
  - 4. Color: White background, black printing.
- I. Type F - Underground Warning Tape:
  - 1. Materials: Polyethylene.
  - 2. Size:
    - a. 6 inches wide (minimum).
    - b. Thickness: 3.5 mils.
  - 3. Fabrication:
    - a. Legend: Preprinted and permanently imbedded.
    - b. Message continuous printed.
    - c. Tensile strength: 1750 psi.
  - 4. Color: As specified.
- J. Type G - Stenciling System:
  - 1. Materials:
    - a. Exterior type stenciling enamel.
    - b. Either brushing grade or pressurized spray can form and grade.
  - 2. Size: As required.
  - 3. Fabrication:
    - a. Legend: As required.

4. Color: Black or white for best contrast.
- K. Underground Tracer Wire:
1. Materials:
    - a. Wire:
      - 1) 12 GA AWG.
      - 2) Solid.
    - b. Wire nuts: Waterproof type.
    - c. Split bolts: Brass.

## **2.3 ACCESSORIES**

- A. Fasteners:
1. Bead chain: #6 brass, aluminum or stainless steel.
  2. Plastic strap: Nylon, urethane or polypropylene.
  3. Screws: Self-tapping, stainless steel.
  4. Adhesive, solvent activated.

## **2.4 MAINTENANCE MATERIALS**

- A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

# **PART 3 - EXECUTION**

## **3.1 GENERAL INSTALLATION**

- A. Install identification devices at specified locations.
- B. All identification devices to be printed by mechanical process, hand printing is not acceptable.
- C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.
- D. Attach tags with 1/8 inches round or flat head screws to equipment without sufficient surface or body area, or porous surfaces.
1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.
- E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing.
1. Several items of equipment mounted in housing to be individually tagged inside the compartment.
- F. Tracer Wire:
1. Attach to pipe at a maximum of 10 feet intervals with tape or tie-wraps.
  2. Continuous pass from each valve box and above grade at each structure.
  3. Coil enough wire at each valve box to extend wire a foot above the ground surface.
  4. 1,000 feet maximum spacing between valve boxes.
  5. If split bolts are used for splicing, wrap with electrical tape.
  6. If wire nuts are used for splicing, knot wire at each splice point leaving 6 inches of wire for splicing.
  7. Use continuous strand of wire between valve box where possible.
    - a. Continuous length shall be no shorter than 100 feet.

## **3.2 SCHEDULES**

- A. Hazard and Safety Signage:
1. Permit Required Confined Space signage:
    - a. Tag Type: Type B2 - Nonmetallic Signs.
    - b. Fastener: Screw or adhesive.

- c. Size: 10 inches x 14 inches.
  - d. Location: As indicated on Drawings.
  - e. Location: Field located as directed by Engineer or Owner.
    - 1) Allowance: Provide 10 signs.
  - f. Legend:
    - 1) OSHA Danger sign.
    - 2) Description of hazard: "PERMIT REQUIRED CONFINED SPACE DO NOT ENTER".
2. Miscellaneous OSHA hazard signage:
- a. Tag Type: Type B2 - Nonmetallic Signs.
  - b. Fastener: Screw or adhesive.
  - c. Size: 10 inches x 14 inches.
  - d. Location: As indicated on Drawings.
  - e. Location: Field located as directed by Engineer or Owner.
    - 1) Allowance: Provide 10 OSHA Danger, Caution, Safety Instruction or Biohazard signs as directed by Engineer or Owner.
  - f. Legend:
    - 1) Description of hazard shall be determined by Engineer or Owner.
    - 2) Provide international graphic symbology where indicated.
3. No Smoking Signage:
- a. Tag Type: Type B2 - Nonmetallic Signs.
  - b. Fastener: Screw or adhesive.
  - c. Size: 10 inches x 14 inches.
  - d. Location: On the doors entering into the rooms with flammable gas or other material requiring No Smoking signage, as indicated on the Drawings.
  - e. Location: Field located as directed by Engineer or Owner.
    - 1) Allowance: Provide 5 "NO SMOKING" signs.
  - f. Legend: "NO SMOKING" with international graphic symbology, adhering to the International Fire Code.
4. Hazardous Material Identification Signage:
- a. Tag Type: Type B2 - Nonmetallic Signs.
  - b. Fastener: Screw or adhesive.
  - c. Size (NFPA Diamond): Per NFPA 704, 10" minimum.
  - d. Size (Hazardous Material name, with concentration % where applicable): 2 inches minimum letters, directly below corresponding NFPA Diamond.
  - e. Location: On the doors entering into the rooms with Hazardous Material [and on the tanks or storage containers of Hazardous Materials], as indicated on the Drawings.
  - f. Location: Field located as directed by Engineer or Owner.
    - 1) Allowance: Provide 2 NFPA 704 Diamond signs.
    - 2) Allowance: Provide 2 for Hazardous Material Name.
  - g. Legend:
    - 1) NFPA 704 Diamond hazard numbers: As directed by Engineer or Owner appropriate for the Hazardous Material.
    - 2) Hazardous Material name: As directed by Engineer or Owner.
- B. Process Systems:
1. General:
- a. Provide arrows and markers on piping.
    - 1) At 20 feet maximum centers along continuous lines.
    - 2) At changes in direction (route) or obstructions.
    - 3) At valves, risers, "T" joints, machinery or equipment.
    - 4) Where pipes pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
  - b. Position markers on both sides of pipe with arrow markers pointing in flow direction.
    - 1) If flow is in both directions use double headed arrow markers.

- c. Apply tapes and stenciling in uniform manner parallel to piping.
- 2. Trenches with piping:
  - a. Tag type: Type F - Underground Warning Tape
  - b. Location: Halfway between top of piping and finished grade.
  - c. Letter height: 1-1/4 inches minimum.
  - d. Natural gas or digester gas:
    - 1) Color: Yellow with black letters.
    - 2) Legend:
      - a) First line: "CAUTION CAUTION CAUTION"
      - b) Second line: "BURIED GAS LINE BELOW"
  - e. Potable water:
    - 1) Color: Blue with black letters.
    - 2) Legend:
      - a) First line: "CAUTION CAUTION CAUTION"
      - b) Second line: "BURIED WATER LINE BELOW"
  - f. Storm and sanitary sewer lines:
    - 1) Color: Green with black letters.
    - 2) Legend:
      - a) First line: "CAUTION CAUTION CAUTION"
      - b) Second line: "BURIED SEWER LINE BELOW"
  - g. (Nonpotable) water piping, except 3 inches and smaller irrigation pipe:
    - 1) Color: Green with black letters.
    - 2) Legend:
      - a) First line: "CAUTION CAUTION CAUTION"
      - b) Second line: "BURIED NONPOTABLE WATER LINE BELOW"
  - h. Chemical feed piping (e.g., chlorine solution, polymer solution, caustic solution, etc.):
    - 1) Color: Yellow with black letters.
    - 2) Legend:
      - a) First line: "CAUTION CAUTION CAUTION"
      - b) Second line: "BURIED CHEMICAL LINE BELOW"
  - i. Other piping (e.g., compressed air, irrigation, refrigerant, heating water, etc.):
    - 1) Color: Yellow with black letters.
    - 2) Legend:
      - a) First line: "CAUTION CAUTION CAUTION"
      - b) Second line: "BURIED PIPE LINE BELOW"
- 3. Yard valves, buried, with valve box and concrete pad:
  - a. Tag type: Type A2 - Rectangle Metal Tags.
  - b. Fastener: 3/16 inches x 7/8 inches plastic screw anchor with 1 inch #6 stainless steel pan head screw.
  - c. Legend:
    - 1) Letter height: 1/4 inches minimum.
    - 2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
- 4. Valves and slide gates:
  - a. Tag type:
    - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
    - 2) Indoor noncorrosive:
      - a) Type A1 - Round Metal Tags.
      - b) Type B1 - Square Nonmetallic Tags.
    - 3) Indoor corrosive:
      - a) Stainless steel Type A1 - Round Metal Tags.
      - b) Type B1 - Square Nonmetallic Tags.
  - b. Fastener:
    - 1) Type A1: Chain of the same material.
    - 2) Type B1: Stainless steel chain.
  - c. Color: Per ASME A13.1 corresponding to the piping system.

- d. Legend:
    - 1) Letter height: 1/4 inches minimum.
    - 2) Valve designation as indicated on the Drawings (e.g., “V-xxx”).
5. Process equipment (e.g., pumps, pump motors, blowers, air compressors, bar screens, clarifier drive mechanism, etc.):
  - a. Tag type:
    - 1) Type B2 - Nonmetallic Signs.
    - 2) Type D - Self-Adhesive Tape Tags and Signs.
    - 3) Type G - Stenciling System.
  - b. Fastener:
    - 1) Self.
    - 2) Screws.
    - 3) Adhesive.
  - c. Legend:
    - 1) Letter height: 1/2 inches minimum.
    - 2) Equipment designation as indicated on the Drawings (e.g., “Primary Sludge Pump P-xxx”).
6. Piping systems:
  - a. Tag type:
    - 1) Outdoor locations: Type G - Stenciling System.
    - 2) Indoor locations:
      - a) Type D - Self-Adhesive Tape Tags and Signs.
      - b) Type G - Stenciling System.
  - b. Fastener: Self.
  - c. Color: Per ASME A13.1.
  - d. Legend:
    - 1) Letter height: Manufacturers standard for the pipe diameter.
    - 2) Mark piping in accordance with ASME A13.1.
    - 3) Use piping designation as indicated on the Drawings.
    - 4) Arrow: Single arrow.
7. Process tanks (over 1000 GAL) and basins, (e.g., chemical storage, clarifiers, trickling filters, digesters, etc.):
  - a. Tag type:
    - 1) Type B2 - Nonmetallic Signs.
    - 2) Type G - Stenciling System.
  - b. Fastener:
    - 1) Screw.
    - 2) Self.
  - c. Location as directed by Owner.
  - d. Legend:
    - 1) Letter height: 4 inches minimum.
    - 2) Equipment designation as indicated on the Drawings (e.g., “Clarifier CL-xxx”).
8. Tanks (less than 1000 GAL) (e.g., break tanks, chemical tanks, hydro-pneumatic tanks, air receivers, etc.):
  - a. Tag type:
    - 1) Type D - Self-Adhesive Tape Tags and Signs.
    - 2) Type G - Stenciling System.
  - b. Fastener: Self.
  - c. Legend:
    - 1) Letter height: 2 inches minimum.
    - 2) Equipment designation as indicated on the Drawings (e.g., “Polymer Storage Tank Txxx”).
9. Equipment that starts automatically:
  - a. Tag type:
    - 1) Type B2 - Nonmetallic Signs.

- 2) Type D - Self-Adhesive Tape Tags and Signs.
  - b. Fastener:
    - 1) Type B2 - Screw or adhesive.
    - 2) Type D - Self.
  - c. Size: 5 inches x 7 inches
  - d. Location: As indicated on the Drawings.
  - e. Legend:
    - 1) OSHA Warning Sign.
    - 2) Description of Warning: "THIS MACHINE STARTS AUTOMATICALLY".
- C. Instrumentation Systems:
- 1. Instrumentation Equipment (e.g., flow control valves, primary elements, etc.):
    - a. Tag type:
      - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
      - 2) Indoor noncorrosive:
        - a) Type A1 - Round Metal Tags.
        - b) Type B1 - Square Nonmetallic Tags.
      - 3) Indoor corrosive:
        - a) Stainless steel Type A1 - Round Metal Tags.
        - b) Type B1 - Square Nonmetallic Tags.
    - b. Fastener:
      - 1) Type A1: Chain of the same material.
      - 2) Type B1: Stainless steel chain.
    - c. Legend:
      - 1) Letter height: 1/4 inches minimum.
      - 2) Equipment ISA designation as indicated on the Drawings (e.g., "FIT-xxx").
  - 2. Enclosure for instrumentation and control equipment, (e.g., PLC control panels, etc.):
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1/2 inches minimum.
      - 2) Equipment name (e.g., "PLC CONTROL PANEL PCP-xxx").
  - 3. Components inside equipment enclosure, (e.g., PLC's, control relays, contactors, and timers):
    - a. Tag type: Type D - Self-Adhesive Tape Tags.
    - b. Fastener: Self.
    - c. Legend:
      - 1) Letter height: 3/16 inches minimum.
      - 2) Description or function of component (e.g., "PLC-xxx" or "CR-xxx").
  - 4. Through enclosure door mounted components (e.g., selector switches, controller digital displays, etc.):
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1/4 inches minimum.
      - 2) Component ISA tag number as indicated on the Drawings (e.g., "HS-xxx").
- D. HVAC Systems:
- 1. General:
    - a. Provide arrows and markers on ducts.
      - 1) At 20 feet maximum centers along continuous lines.
      - 2) At changes in direction (route) or obstructions.
      - 3) At dampers, risers, branches, machinery or equipment.
      - 4) Where ducts pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
    - b. Position markers on both sides of duct with arrow markers pointing in flow direction.

- 1) If flow is in both directions use double headed arrow markers.
  - c. Apply tapes and stenciling in uniform manner parallel to ducts.
  2. HVAC Equipment (e.g., unit heaters, exhaust fans, air handlers, etc.):
    - a. Tag type:
      - 1) Type B2 - Nonmetallic Signs.
      - 2) Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1 inch minimum.
      - 2) Equipment designation as indicated on the Drawings (e.g., "EF-xxx").
  3. Ductwork:
    - a. Tag type:
      - 1) Type D - Self-Adhesive Tape Tags and Signs.
      - 2) Type G - Stenciling System.
    - b. Fastener: Self.
    - c. Legend:
      - 1) Letter height: 1 inch minimum.
      - 2) Description of ductwork, (e.g., "AIR SUPPLY").
      - 3) Arrows: Single arrow.
  4. Enclosure for instrumentation and control equipment, (e.g., fan control panels, etc.):
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1/2 inches minimum.
      - 2) Equipment designation as indicated on the Drawings (e.g., "FAN CONTROL PANEL FCP-xxx").
  5. Wall mounted thermostats:
    - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
    - b. Fastener: Self.
    - c. Legend:
      - 1) Letter height: 3/16 inches minimum.
      - 2) Description of equipment controlled (e.g., "UH-xxx" or AHU-xxx").
  6. Components inside equipment enclosure, (e.g., controller's, control relays, contactors, and timers):
    - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
    - b. Fastener: Self.
    - c. Legend:
      - 1) Letter height: 3/16 inches minimum.
      - 2) Description or function of component (e.g., "CR-xxx").
  7. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1/4 inches minimum.
      - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
- E. Electrical Systems:
1. Trenches with ductbanks, direct-buried conduit, or direct-buried wire and cable.
    - a. Tag type: Type F - Underground Warning Tape.
    - b. Letter height: 1-1/4 inches minimum.
    - c. Location:
      - 1) Where trench is 12 inches or more below finished grade: In trench 6 inches below finished grade.

- 2) Where trench is less than 12 inches below finished grade: In trench 3 inches below finished grade.
- d. Electrical power (e.g., low and medium voltage):
  - 1) Color: Red with black letters.
  - 2) Legend:
    - a) First line: "CAUTION CAUTION CAUTION".
    - b) Second line: "BURIED ELECTRIC LINE BELOW".
- e. Communications (e.g., telephone, instrumentation, LAN, SCADA):
  - 1) Color: Orange with black letters.
  - 2) Legend:
    - a) First line: "CAUTION CAUTION CAUTION".
    - b) Second line: "BURIED COMMUNICATION LINE BELOW".
- 2. Switchgear, switchboards and motor control centers:
  - a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Main equipment legend:
    - 1) Letter height:
      - a) First line: 1 inch minimum.
      - b) Subsequent lines: 3/8 inches minimum.
    - 2) First line: Equipment name (e.g., "MAIN SWITCHBOARD MSBxxx").
    - 3) Second line:
      - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
      - b) Include the building name or number if the source is in another building.
    - 4) Third line: System voltage and phase (e.g., "480/277 V, 3PH").
    - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
  - d. Main and feeder device legend:
    - 1) Letter height: 3/8 inches minimum.
    - 2) Description of load (e.g., "MAIN DISCONNECT", "PUMP Pxxx" or "PANELBOARD HPxxx").
- 3. Panelboards and transformers:
  - a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Legend:
    - 1) Letter height:
      - a) First line: 3/8 inches minimum.
      - b) Subsequent lines: 3/16 inches minimum.
    - 2) First line: Equipment name (e.g., "PANELBOARD LPxxx" or "TRANSFORMER Txxx").
    - 3) Second line (panelboards only): System voltage and phase (e.g., "208/120V, 3PH").
    - 4) Third line:
      - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
      - b) Include the building name or number if the source is in another building.
    - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
- 4. Transfer switches:
  - a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Legend:
    - 1) Letter height:
      - a) First line: 3/8 inches minimum.
      - b) Subsequent lines: 3/16 inches minimum.
    - 2) First line: Equipment name (e.g., "AUTOMATIC TRANSFER SWITCH ATSxxx").
    - 3) Second line: Normal source of power (e.g., "NORMAL SOURCE FED FROM MCCxxx").



- 4) Third line: Emergency source of power (e.g., "EMERGENCY SOURCE FED FROM SGENxxx").
  - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
5. Safety switches, separately mounted circuit breakers and motor starters, VFD's, etc.:
  - a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Legend:
    - 1) Letter height: 1/4 inches minimum.
    - 2) First line: Description of load equipment is connected to (e.g., "PUMP Pxxx").
    - 3) Second line:
      - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
      - b) The source of power room number is only required when there are multiple electrical rooms, if the source is in another building, the building name or number shall be used.
6. Enclosure for instrumentation and control equipment, (e.g., lighting control panels, etc.):
  - a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Legend:
    - 1) Letter height: 1/2 inches minimum.
    - 2) Equipment name (e.g., "LIGHTING CONTROL PANEL LCPxxx").
7. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):
  - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
  - b. Fastener: Self.
  - c. Legend:
    - 1) Letter height: 3/16 inches minimum.
    - 2) Description or function of component (e.g., "M-xxx", "CR-xxx" or "TR-xxx").
8. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
  - a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Legend:
    - 1) Letter height: 1/4 inches minimum.
    - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
9. Conductors in control panels and in pull or junction boxes where multiple circuits exist.
  - a. Tag type: Type D - Self-Adhesive Tape Tags.
  - b. Fastener: Self.
  - c. Tag conductor at both ends.
  - d. Legend:
    - 1) Letter height: 1/8 inches minimum.
    - 2) Circuit number or wire number as scheduled on the Drawings or as furnished with the equipment.
10. Conductors in handholes and manholes.
  - a. Tag type: Type A3 - Metal Tape Tags.
  - b. Fastener: Nylon strap.
  - c. Tag conductor at both ends.
  - d. Legend:
    - 1) Letter height: 1/8 inches minimum.
    - 2) Circuit number or wire number as scheduled on the Drawings.
11. Grounding conductors associated with grounding electrode system in accordance with the following:
  - a. Tag type: Type D - Self-Adhesive Tape Tags.
  - b. Fastener: Self.
  - c. Legend:

- 1) Letter height: 1/8 inches minimum.
  - 2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND RING", "TO MAIN WATER PIPE").
12. Flash protection for switchboards, panelboards, industrial control panels and motor control centers:
  - a. Tag type: Type D - Self-Adhesive Tape Signs.
  - b. Fastener: Self.
  - c. Legend: Per NFPA 70.
13. Entrances to electrical rooms:
  - a. Tag type: Type B2 - Nonmetallic Signs.
  - b. Fastener: Screw or adhesive.
  - c. Size: 5 inches x 7 inches.
  - d. Location: Each door to room.
  - e. Legend:
    - 1) OSHA Danger Sign.
    - 2) Description of Danger: "HIGH VOLTAGE, AUTHORIZED PERSONNEL ONLY".
14. Equipment where more than one voltage source is present:
  - a. Tag type:
    - 1) Type B2 - Nonmetallic Signs.
    - 2) Type D - Self-Adhesive Tape Signs.
  - b. Fastener:
    - 1) Screw or adhesive.
    - 2) Self.
  - c. Size: 1-3/4 inches x 2-1/2 inches.
  - d. Location: Exterior face of enclosure or cubical.
  - e. Legend:
    - 1) OSHA Danger Sign.
    - 2) Description of Danger: "MULTIPLE VOLTAGE SOURCES".

## END OF SECTION

**SECTION 10 44 33**  
**FIRE PROTECTION SPECIALTIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Portable fire extinguishers.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 05 50 00 - Metal Fabrications.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Americans with Disabilities Act (ADA):
    - a. 2010 ADA Standards for Accessible Design.
  - 2. National Fire Protection Association (NFPA):
    - a. 10, Standard for Portable Fire Extinguishers.
  - 3. Underwriters Laboratories, Inc. (UL):
    - a. 8, Water Based Agent Fire Extinguishers.
    - b. 154, Carbon Dioxide Fire Extinguishers.
    - c. 299, Dry Chemical Fire Extinguishers.
    - d. 626, Water Fire Extinguishers.
    - e. 711, Rating and Fire Testing of Fire Extinguishers.
    - f. 2129, Halocarbon Clean Agent Fire Extinguishers.

**1.3 DEFINITIONS**

- A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Ratings and classification of extinguishers.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and install filled and charged extinguishers just prior to building occupancy.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Fire extinguishers:
    - a. Amerex Corporation.
    - b. Ansul – Tyco Fire Protection Products.
    - c. Badger Fire Protection.
    - d. United Technologies - Kidde.
    - e. Buckeye Fire Equipment.
  - 2. Fire extinguisher signs:
    - a. Seton.
    - b. Compliance Signs.
    - c. Safety Sign.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

### **2.2 MANUFACTURED UNITS**

- A. Fire Extinguisher (FEXT):
  - 1. Steel bodied, all metal top (head) and valves.
  - 2. Multi-purpose dry chemical extinguisher with hose and nozzle.
  - 3. Provide one (1) listed 10 LB. 4A-60BC extinguisher for each fire extinguisher location (FEXT) indicated on Drawings.
  - 4. Finish: Red with epoxy finish coat.
- B. Wall Brackets:
  - 1. Bracket type to fit specified extinguisher.
  - 2. Furnish bracket for each extinguisher not in cabinet.
  - 3. Bracket to be finished in red or black enamel.
- C. Fire Extinguisher Signage:
  - 1. Single faced: SETON #21999.
  - 2. Double faced: SETON #22001.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions and NFPA 10.
  - 1. Install units with extinguisher top not over 48 IN above floor.
  - 2. Install wall brackets to concrete or masonry substrate with self-tapping concrete anchors.
    - a. See Specification Section 05 50 00.
- B. Fire extinguisher locations shown on Drawings are approximate locations.
  - 1. Verify all extinguisher mounting locations with the AHJ.
- C. Provide "FIRE EXTINGUISHER" sign for each extinguisher location.
  - 1. Provide single or double faced sign to provide optimum visibility for extinguisher location.

### **END OF SECTION**



## DIVISION 23

**HEATING, VENTILATING, AND AIR  
CONDITIONING (HVAC)**



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## **SECTION 23 05 13**

### **COMMON MOTOR REQUIREMENTS FOR PLUMBING AND HVAC EQUIPMENT**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Equipment furnished for plumbing and HVAC systems.
  - 2. Single phase motors for plumbing and HVAC equipment.
  - 3. Three-phase motors for plumbing and HVAC equipment.
  - 4. Motors shipped loose for installation in plumbing and HVAC equipment.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 07 92 00 - Joint Sealants.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Bearing Manufacturers Association (ABMA).
  - 2. International Electrotechnical Commission (IEC).
  - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. ICS 6, Enclosures for Industrial Control and System.
    - c. MG 1, Motors and Generators.
  - 5. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC):
      - 1) Article 430, Motors, Motor Circuits, and Controllers.
  - 6. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
  - 7. Underwriters Laboratories, Inc. (UL):
    - a. 508a, Standard for Industrial Control Panels.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Equipment technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Data sheets that include manufacturer's name and complete product model number.
      - 1) Clearly identify all optional accessories that are included.
    - c. Equipment identification utilizing numbering system and name utilized in Drawings.
    - d. Equipment installation details:
      - 1) Location of anchorage.
      - 2) Type, size, and materials of construction of anchorage.
      - 3) Anchorage setting templates.
      - 4) Manufacturer's installation instructions.
    - e. Equipment physical characteristics:
      - 1) Dimensions (both horizontal and vertical).
      - 2) Materials of construction and construction details.
      - 3) Shipping and operating weight.

- 4) Duct and piping connection sizes, type and location.
- f. Equipment lining and coatings:
  - 1) Equipment factory primer and paint data.
- g. Operating characteristics:
  - 1) Utility requirements, natural gas, electric and other.
  - 2) Performance curves.
  - 3) Equipment capacity and efficiency.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, refer to individual equipment Specification Sections for acceptable manufacturers.
- B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Motors:
    - a. Baldor.
    - b. General Electric.
    - c. Marathon Electric.
    - d. Reliance Electric.
    - e. Siemens.
    - f. Teco-Westinghouse.
    - g. U.S. Motors.
    - h. WEG.
- C. Submit request for substitution in accordance with Specification Section 01 33 00.

### **2.2 MANUFACTURED UNITS**

- A. Equipment: Refer to individual equipment Specification Sections for product requirements.
- B. Electric Motors:
  - 1. Design for frequent starting duty equivalent to duty service required by driven equipment.
  - 2. Design for full voltage starting.
  - 3. Design bearing life based upon actual operating load conditions imposed by driven equipment.
  - 4. Size for altitude of Project.
  - 5. Furnish with stainless steel nameplates which include all data required by NFPA 70 (NEC), Article 430.
  - 6. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.
  - 7. AC electric motors less than 1/3 HP:
    - a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Permanently lubricated sealed bearings conforming to ABMA standards.
    - c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
  - 8. AC electric motors 1/3 to 1 HP:
    - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Permanently lubricated sealed bearings conforming to ABMA standards.



- 1) For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
9. AC electric motors 1-1/2 to 10 HP:
  - a. 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
  - b. Permanently lubricated sealed bearings conforming to ABMA standards.
  - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
10. AC electric motors greater than 10 HP:
  - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
  - b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
    - 1) Design bearing life for 90 percent survival rating at 50,000 HRS of operation for motors up to and including 100 HP.
    - 2) For motors greater than 100 HP, design bearing life for 90 percent survival rating at 100,000 HRS of operation.
  - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
11. Severe duty motor to have the following minimum features:
  - a. All cast iron construction.
  - b. Gasketed conduit box.
  - c. Epoxy finish for corrosion protection.
  - d. Hydrosopic varnish on windings for corrosion protection.
  - e. Drain plug and breather.
- C. NEMA Design Squirrel Cage Induction Motors:
  1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
  2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
  3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
  4. For use on variable frequency type adjustable speed drives, provide:
    - a. Induction motors that are in compliance with NEMA MG 1, Part 31.
    - b. Nameplate identification meeting NEMA MG 1, Part 31 requirements.
    - c. Insulated drive end bearing on all motors.
    - d. Shaft grounding ring on all motors:
      - 1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
      - 2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
  5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 DegC ambient.
  6. Design motors for continuous duty.
  7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 percent greater than the maximum HP requirements of the driven equipment over its entire operating range.
    - a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
  8. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.
- D. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.
- E. V-Belt Drive:

1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
3. Provide staticproof belts.

## **2.3 ACCESSORIES**

- A. Guards:
  1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
  2. Interior applications:
    - a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
    - b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
    - c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
  3. Exterior applications:
    - a. Construct from 16 GA stainless steel or aluminum.
    - b. Construct to preclude entrance of rain, snow, or moisture.
    - c. Roll to conform to shaft or coupling surface.
    - d. Connect to equipment frame with stainless steel bolts and wing nuts.
- B. Data Plate:
  1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
  2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.
- C. Lifting Eye Bolts or Lugs:
  1. Provide on all equipment 50 LBS or greater.
  2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.

## **2.4 FABRICATION**

- A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.
- B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.
- C. Furnish like parts of duplicate units to be interchangeable.
- D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.
- E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
  1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.
- F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
  1. Provide drain connection for 3/4 IN PVC tubing.
- G. Machine the mounting feet of rotating equipment.
- H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that cannot be properly prepared and painted.
  1. When such back to back fabrication cannot be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
  2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Specification Section 07 92 00.

- I. Critical Speed:
  - 1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
  - 2. Excessive vibration is sufficient cause for equipment rejection.
  - 3. Ratio of all rotative speeds to critical speed of a unit or components: Greater than 1.2.
- J. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
  - 1. Manufacturer's standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
  - 2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
  - 3. Affix entire assembly with a UL 508A label "Listed Enclosed Industrial Control Panel" prior to delivery.
    - a. Control panels without an affixed UL 508A label shall be rejected.

## **2.5 SOURCE QUALITY CONTROL**

- A. The Owner reserves the right to select and have tested any motor included within the project.
  - 1. If motor passes testing requirements, Owner shall be responsible for any shipping and testing costs incurred.
  - 2. Costs shall be determined by current freight rates and manufacturer's published rates at the time of the test.
  - 3. If motor fails test, Supplier shall be responsible for all costs incurred.
  - 4. If two (2) successive motors fail the test, the Owner has the right to reject any or all motors from that manufacturer.
  - 5. The Owner also reserves the right to witness any routine or complete tests at the Owner's expense.
  - 6. Notify the Owner a minimum of 14 days in advance of the testing.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.
- B. Utilize templates for anchorage placement for slab-mounted equipment.
- C. For equipment having drainage requirements such as condensate, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain.
  - 1. Route clear of major traffic areas and as approved by Engineer.
- D. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings from closest operating floor level.
- E. Equipment Base:
  - 1. Construct level in both directions.
  - 2. Take particular care at anchor bolt locations so these areas are flat and level.
- F. Machine Base:
  - 1. Mount machine base of rotating equipment on equipment base.
    - a. Level in both directions, using a machinist level, according to machined surfaces on base.
  - 2. Level machine base on equipment base and align couplings between driver and driven unit using steel blocks and shims.
    - a. Size blocks and shims to provide solid support at each mounting bolt location.
      - 1) Provide area size of blocks and shims approximately 1-1/2 times area support surface at each mounting bolt point.
    - b. Provide blocks and shims at each mounting bolt.

- 1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on mounting bolts.
  - c. After all leveling and alignment has been completed and before grouting, tighten mounting bolts to proper torque value.
- G. Couplings:
1. Align in the annular and parallel positions.
    - a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller.
      - 1) Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
    - b. For equipment rotating at speeds greater than 1200 rpm allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
  2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
  3. Check surfaces for runout before attempting to trim or align units.
- H. Grouting:
1. After machine base has been shimmed, leveled onto equipment base, couplings aligned and mounting bolts tightened to correct torque value, place a dam or formwork around base to contain grouting between equipment base and equipment support pad.
    - a. Extend dam or formwork to cover leveling shims and blocks.
    - b. Do not use nuts below the machine base to level the unit.
  2. Saturate top of roughened concrete subbase with water before grouting.
    - a. Add grout until entire space under machine base is filled to the top of the base underside.
    - b. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.
  3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface.
    - a. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout.
    - b. When the grout has fully hardened (after a minimum of seven (7) days) tighten all anchor bolts to engage equipment base to grout, shims, and equipment support pad.
    - c. Recheck driver-driven unit for proper alignment.

### 3.2 INSTALLATION CHECKS

- A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
  1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.
- B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
  1. Has been properly installed and lubricated.
  2. Is in accurate alignment.
  3. Is free from any undue stress imposed by connecting piping or anchor bolts.
  4. Has been operated under full load conditions and that it operated satisfactorily.
    - a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.
- C. No separate payment shall be made for installation checks.
  1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

### **3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS**

- A. Identify equipment and install hazard warning signs.

### **3.4 WIRING CONNECTIONS AND TERMINATION**

- A. Clean wires before installing lugs and connectors.
- B. Coat connection with oxidation eliminating compound for aluminum wire.
- C. Terminate motor circuit conductors with copper lugs bolted to motor leads.
- D. Tape stripped ends of conductors and associated connectors with electrical tape.
  - 1. Wrapping thickness shall be 150 percent of the conductor insulation thickness.
- E. Connections to carry full ampacity of conductors without temperature rise.
- F. Terminate spare conductors with electrical tape.

**END OF SECTION**

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**SECTION 23 30 00**  
**HVAC AIR DISTRIBUTION**

**PART 1 - GENERAL**

**1.1 WORK INCLUDES**

- A. Base Bid:
  - 1. Contractor shall provide:
    - a. All items specified herein and shown on the Drawings and certified testing and balancing of air flow for heat recovery ventilators and exhaust fans.
  - 2. Products Included:
    - a. Unit Heaters
    - b. Louvers
    - c. Damper
    - d. Damper Actuators
    - e. Duct Insulation
    - f. Thermostats
    - g. Ductwork
    - h. Duct Accessories
    - i. Heat Recovery Ventilators
    - j. Exhaust Fans
    - k. Mini Makeup Air Handlers

**1.2 RELATED REQUIREMENTS**

- A. Specified elsewhere:
  - 1. Section 23 05 13 – Common Motor Requirements for Plumbing and HVAC

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00.
- B. Color charts:
  - 1. Louvers.
- C. Manufacturer's Product Data:
  - 1. Submit product data on all items in this Section except ductwork and duct accessories.
  - 2. Submit product data showing capacities, tolerances, construction, power requirements, dimensions, performance curves, sound data, required clearance, furnished specialties, accessories, installation, and startup instructions, as required on Plans, Schedules, and Specifications.
  - 3. Where catalog cuts are used that show more than one model the data applying to the submitted model shall be clearly marked. Submittals not so marked will be returned without review.
  - 4. The damper manufacturer's submittal data shall certify all air performance pressure drop data is licensed in accordance with the AMCA certified ratings program for Test Figures 5.2, 5.3 and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D.
  - 5. Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval showing damper suitable for pressures to 5 in. w.g., velocities to 3,000 fpm and temperatures to 180°F.
  - 6. Damper manufacturer's printed performance data showing standard air leakage equal to or less than that scheduled shall be submitted for approval.

- D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting, securing, and flashing of roof curb to roof structure.
  - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- E. Maintenance and Operating Instructions: See Section 01 33 04.

#### **1.4 QUALITY ASSURANCE:**

- A. Energy Efficiency Ratio: Equal to or greater than that prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- B. Listing and Labeling: Provide electrically operated components specified in the Section that are listed and labeled by an approved Safety Agency.
- C. All motors provided under this Specification shall be of "Premium" efficiency unless noted otherwise.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Coordinate delivery of units in sufficient time to allow movement into the building.

#### **1.6 WARRANTY**

- A. In addition to Contractor's warranty specified elsewhere, provide five (5) year parts and labor warranty on all refrigerant compressors.
- B. Gas Furnace heat exchangers shall have 20 year parts and labor warranty.
- C. Gas unit heaters shall have Nine (9)-year, non-prorated warranty on the heat exchanger, burners and flue collection box assembly and four (4)-year, non-prorated warranty on all electrical and mechanical operating components, except blower belts.
- D. Certified testing and balancing report for heat recovery ventilator air flow.

### **PART 2 - PRODUCTS**

#### **2.1 UNIT HEATERS**

- A. Gas (propane) Fired:
  - 1. Units shall be a minimum of 82% high-efficiency, power vented, separated combustion, gas fired unit heaters.
  - 2. Heat Exchanger: The heater shall be equipped with a multi-cell, 4 pass serpentine style steel heat exchanger. Heat exchanger tubes shall be press fabricated of aluminized steel.
  - 3. Burner: The units shall incorporate a single, one-piece burner assembly with a single orifice. The burner shall have a continuous wound close pressed stainless steel ribbon separating the flame from the burner interior. Each heat exchanger cell shall use balanced draft induction to maintain optimum flame control.
  - 4. Controls: Controls shall include a single-stage gas valve; direct spark multi-try ignition with electronic flame supervision with 100% lockout integrally controlled via a printed circuit control board. The control board shall also incorporate diagnostic lights, DIP switches for blower overrun settings, and a relay for blower only operation. All open blower motors shall have automatic thermal overload protection or be equipped with a factory installed motor starter with adjustable thermal overloads. All units shall be equipped with a safety limit switch. All controls shall be enclosed in the sealed control compartment to protect them from accidental damage, dust, and atmospheric corrosion. Provide master/slave/slave/slave controls by manufacturer to permit operation of up to 4 unit heaters with one thermostat, where shown on drawings.



5. Combustion Air and Venting: The unit shall have a factory-installed power venter device to draw outside combustion air through an inlet duct attaching to the rear of the cabinet. The combustion air/venting system shall include a vibration isolated power venter motor and wheel assembly and a combustion air pressure switch. Venting shall be in accordance with manufacturer's installation instructions and shall include concentric adapter kit and concentric roof termination.
6. Electrical: Operation shall be controlled by an integrated circuit board that includes LED diagnostic indicator lights. Supply voltage connections shall be made at the circuit board. 24 volt control connections shall be made on an externally mounted terminal strip with connections W1, W2, R, and G. Units shall be equipped with a 115 volt power supply.
7. Blower: Units shall be equipped with a centrifugal blower or propeller fan, as scheduled, with direct drive from an open drip-proof motor with internal overloads.
8. Cabinet: The unit shall be designed for ceiling suspension featuring 3/8"-16 female threads at 4 point locations. Contractor shall provide rubber in shear vibration isolation on all 4 hangers. The cabinet shall be equipped with painted, roll-formed horizontal louvers. Louvers shall be spring held and adjustable for directing airflow.
9. Certifications: All units shall be design certified to ANSI Z83.8 and CSA 2.6 for commercial/industrial installation. Units shall be manufactured in an ISO 9001 certified facility.
10. Warranties: Nine (9)-year warranty on the heat exchanger, burners, and flue collection box assembly.  
Manufacturers:
  - a. Reznor
  - b. Sterling
11. Contractor shall be responsible for coordinating with Propane Gas Supplier to provide a concrete pad suitable for supporting a propane tank to supply the fuel for the unit heater.
12. Contractor shall be responsible for coordinating with Propane Gas Supplier to provide suitable piping, valves and connections between the propane tank and unit heater.

## 2.2 LOUVERS

- A. Louvers shall be stationary type with drainable blades in a 6" louver frame.
- B. Each stationary blade shall incorporate an integral drain gutter and each jamb shall incorporate an integral downspout so water drains to blade end, then down the downspouts and out at the louver sill rather than cascading down from blade to blade.
- C. Louvers shall be drainable type fabricated from 6063T5 aluminum extrusions of 0.081" nominal wall thickness. Blades shall be positioned at 37° and 45° angles approximately on 4" centers. Each louver shall be equipped with a rear-mounted bird screen of 3/4" X 0.051" expanded, flattened aluminum and an aluminum insect screen.
- D. Louvers shall have the following options:
  1. Flanged frame
  2. Bird Screen
  3. Insect Screen
  4. 70% Kynar finish warranted for 10 years or better, color selected by Owner.
- E. Manufacturers:
  1. Ruskin
  2. Greenheck

## 2.3 DAMPERS

- A. Dampers shall consist of:
  1. 0.125" aluminum channel frame insulated with polystyrene on four sides and thermally broken with dual polyurethane resin gaps.
  2. Aluminum blade internally insulated with polyurethane foam and thermally broken.

1. Axle shall be 1/2" diameter plated steel
  2. Bearings shall be dual bearing with acetal inner sleeve, flanged outer bearing resulting in no metal-to-metal or metal-to-plastic contact
  3. Blade and jamb seals shall be silicone rubber and external (out of the airstream) blade-to-blade linkage.
  4. Concealed linkage.
  5. Damper shall be suitable for velocities to 4000 fpm and temperatures to 200 °F.
  6. Provide in galvanized sleeve with removable framed aluminum or stainless steel insect screen.
  7. Damper actuator as specified later this Section.
- B. Acceptable Manufacturers:
1. Greenheck
  2. Tamco
  3. Ruskin

## 2.4 COMBINATION LOUVERS

- A. Frame and stationary front blades of construction and finish as specified earlier for louvers and integral damper with sleeve and screen as specified earlier for dampers except insulation and thermal breaks are not required.
- B. Manual operator on concealed linkage.
- C. Greenheck or equal.

## 2.5 DAMPER ACTUATORS

- A. Damper motors shall be electric, two positions, spring return, 120V type (unless other voltage is shown on the drawings), 160° stroke with double ended shaft. Motors shall directly couple to one of the primary damper blade shafts. Include all necessary linkage and shafts, etc., for the control of louver type dampers.
- B. Actuators provided shall be designed for frequent operation. Actuators for smoke / fire dampers that are designed for only infrequent operation are not acceptable.
- C. The motors shall be provided with the manufacturer's unconditional two (2) year warranty.
- D. Acceptable maker is Belimo.

## 2.6 DUCT INSULATION

- A. Provide 3/4" thick elastomeric pipe insulation on outside air intake ducts to Heat Recovery Ventilators
- B. Exterior Foil Faced Fiberglass Ductboard Insulation (around intake dampers):
  1. 2" rigid molded glass fiberboards, conforming to ASTM C612, with vapor barrier (Reinforced Foil Kraft).
  2. Thermal conductivity k = 0.23 at 75°F.
  3. Density shall be three (3) pounds per cubic foot.
  4. Manufacturers:
 

a. Schuller/Manville Spin-Glas	814 FSK
b. Owens-Corning	Type 703 FRK
c. Certain Teed	1B 300 FSK

## 2.7 THERMOSTATS

- A. Heating only and Cooling only industrial thermostats:
  1. Shall:
    - a. Be provided to control the equipment shown on the drawings.
    - b. Be capable of switching low voltage control circuit (24 volts).



- I. Listing: ETL or UL listed.
- J. Performance and models: See schedule in Drawings.
- K. Provide adjustable round supply and adjustable round return diffusers of plastic, aluminum or galvanized steel, not necessarily by HRV maker.
- L. Provide intake wall caps and exhaust caps as indicated in the Drawings, not necessarily by HRV maker.
- M. HRV Manufacturers:
  - 1. Fantech
  - 2. Broan
  - 3. Or Equal

## **2.11 WALL-MOUNTED CENTRIFUGAL EXHAUST FANS:**

- A. AMCA certified for air flow and sound.
- B. Non-overloading horsepower capabilities.
- C. Materials:
  - 1. Housing: Spun aluminum.
  - 2. Wheel: Aluminum.
  - 3. Drive shaft: Stainless steel.
  - 4. Minimum 10 GA motor mounting plate.
- D. Backward inclined blades.
- E. Statically and dynamically balanced wheel.
- F. Weathertight compartment for motor and drives.
  - 1. Separated from airstream.
- G. Motor:
  - 1. Vibration isolated motor assembly.
  - 2. Integral attachment collar.
  - 3. Permanently lubricated heavy duty ball bearings.
- H. Accessories:
  - 1. Aluminum birdscreen.
  - 2. Insulated aluminum gravity backdraft damper with conduit hole such as Ventex 1900 series.
- I. Size and capacity and other accessories as scheduled on Drawings.
- J. Greenheck or Loren Cook

## **2.12 MINI MAKE UP AIR HANDLERS**

- A. Frame shall be corrosion-resistant and made of galvanized steel.
- B. Heating coils shall be of High Grade Nickel Chromium alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame. Coil terminals shall be stainless steel, insulated by means of non-rotating ceramic bushings.
- C. Safety Controls
  - 1. Hi-limit with damper shutdown and alarm
  - 2. Low-limit with damper shutdown and alarm
  - 3. High temperature automatic reset thermal cutout that will reset automatically after cool off
  - 4. Manual reset
- D. STANDARD BUILT IN COMPONENTS
  - 1. Fan speed controller
  - 2. Duct Temperature sensor

3. Fan
  4. Damper
  5. Washable filter
  6. Built in Electronic controller (SCR) - ON/OFF components will not be accepted
  7. Current sensor available on all units or Wall mounted push button fan control for models 100 cfm
- E. SIZE AND CAPACITY
1. Collar size, heater kw's, volts and phase, shall be as per Mini Make up Air schedule.
- F. INTERNAL WIRING
1. All internal wiring shall terminate on clearly identified terminal blocks.
  2. A wiring diagram shall be installed on the control box cover
  3. Prior to shipping, all units shall withstand tests as required by CSA/UL.
- G. MOUNTING METHOD
1. Unit must have inlet/outlet collars to accommodate job requirement •
  2. The unit shall have hanger brackets designed to be used with threaded rods. Spring isolators or other means, may be added to the rods as an option to reduce vibration

## **PART 3 - EXECUTION**

### **3.1 DUCT INSULATION INSTALLATION**

- A. Foil Faced Fiberglass Duct Board Insulation:
1. Outside air ducts shall be insulated with fiberglass board insulation exterior to duct and ductliner on duct interior. See Section 15250 for ductliner.
  2. Ductwork shall be covered by adhering insulation with mechanical fasteners such as weld pins or stick clips. Fasteners shall be located not less than 3" from each edge or corner of the board. Pin spacing along the duct should be no greater than 12" on centers. Additional pins or clips may be required to hold the insulation tightly against the surface where cross breaking is used for stiffening. Weld pin lengths must be selected to ensure tight fit but avoid "oil canning." Use faced material on outer layer only in multiple layer applications. Cover pins and clips with vapor sealing pressure-sensitive patches matching insulation facing. Rub hard with a nylon-sealing tool to ensure a tight bond and a vapor seal.
  3. Make corners by miter cutting the insulation such that the surface vapor barrier is maintained. No corners shall be uncovered leaving exposed edges of the insulation.
  4. All voids and cracks shall be filled to the level of the insulation. All insulation joints shall be sealed with pressure-sensitive joint sealing tape to match the insulation facing. Rub hard with a nylon-sealing tool to affect a tight bond. Use three (3)-inch wide tape on flat surfaces, or where edges are shiplapped and stapled. Five (5)-inch wide tape may be used in lieu of shiplapping. All sheet metal duct joints shall be sealed prior to insulating.
  5. Install the specified weatherproof membrane covering system in accordance with manufacturer instructions.
  6. Flash and seal the wall penetrations into the building weathertight.

### **3.2 INSTALL ALL OTHER EQUIPMENT IN ACCORDANCE WITH MANUFACTURER'S PRINTED INSTRUCTIONS.**

### **3.3 TESTING AND BALANCING**

- A. Contractor have certified testing and balancing performed for air flow of the heat recovery ventilator and exhaust fans and submit report.

### **3.4 DUCT INSTALLATION**

- A. All ductwork shall be field or shop fabricated in accordance with recommendations of the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

- B. All ducts shall be of inside size indicated on Drawings. In no case shall the Contractor change the indicated sizes of ductwork without written approval.
- C. All ducts shall be properly braced, stiffened and/or cross braced such that no pulsation or rattling will occur. Bracing and stiffening materials and duct shall be of galvanized steel.

**END OF SECTION**



DIVISION 26

ELECTRICAL



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**SECTION 26 05 00**  
**ELECTRICAL - BASIC REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Basic requirements for electrical systems.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
  - 4. Section 26 05 33 - Raceways and Boxes.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Aluminum Association (AA):
    - a. ADM, Aluminum Design Manual.
  - 2. American Iron and Steel Institute (AISI):
    - a. 325, Manual of Steel Construction.
  - 3. ASTM International (ASTM):
    - a. A36, Standard Specification for Carbon Structural Steel.
    - b. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 4. ETL Testing Laboratories (ETL).
  - 5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C2, National Electrical Safety Code (NESC).
  - 6. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 7. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 8. Underwriters Laboratories, Inc. (UL).
- B. Where UL test procedures have been established for the product type, use UL or ETL approved electrical equipment and provide with the UL or ETL label.

**1.3 DEFINITIONS**

- A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
  - 1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
  - 2. Non-architecturally finished interior area: Pump, mechanical, electrical rooms and other similar process type rooms.
  - 3. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of submittal process.

2. See Specification Section 01 61 03 and individual specification sections for submittal requirements for products defined as equipment.
3. General requirements:
  - a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
  - b. Include data sheets that include manufacturer's name and product model number.
    - 1) Clearly identify all optional accessories.
  - c. Acknowledgement that products are UL or ETL listed or are constructed utilizing UL or ETL recognized components.
  - d. Manufacturer's delivery, storage, handling and installation instructions.
  - e. Product installation details.
  - f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
  - g. See individual specification sections for any additional requirements.
- B. Operation and Maintenance Manuals:
  1. See Specification Section 01 33 04 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content process of Operation and Maintenance Manuals.
- C. When a Specification Section includes products specified in another Specification Section, each Specification Section shall have the required Shop Drawing transmittal form per Specification Section 01 33 00 and all Specification Sections shall be submitted simultaneously.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. See Specification Section 01 65 50.
- B. Protect nameplates on electrical equipment to prevent defacing.

## **1.6 AREA DESIGNATIONS**

- A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
  1. Outdoor areas:
    - a. Wet.
  2. Indoor areas:
    - a. Damp.
  3. Refer to Electrical Equipment Installation Schedule on Drawing 00E-651 for specific area designations and material requirements.

# **PART 2 - PRODUCTS**

## **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, refer to specific Electrical Specification Sections and specific material paragraphs below for acceptable manufacturers.
- B. Submit request for substitution in accordance with Specification Section 00 72 13.
- C. Provide all components of a similar type by one (1) manufacturer.

## **2.2 MATERIALS**

- A. Electrical Equipment Support Pedestals and/or Racks:
  1. Approved manufacturers:
    - a. Modular strut:
      - 1) Unistrut Building Systems.
      - 2) Eaton B-Line.
      - 3) Globe Strut.
  2. Material requirements:

- a. Modular strut:
    - 1) Galvanized steel: ASTM A123/123M or ASTM A153/A153M.
  - b. Structural members (e.g., I beams, L and C channels):
    - 1) Galvanized steel: ASTM A36 steel with galvanizing per ASTM A123/A123M.
    - 2) Aluminum: AA Type 6061-T6 or 6063-T6.
  - c. Mounting plates:
    - 1) Galvanized steel: ASTM A36 steel with galvanizing per ASTM A123/A123M.
    - 2) Aluminum: AA Type 6063-T6.
  - d. Mounting hardware:
    - 1) Galvanized steel.
    - 2) Stainless steel.
  - e. Anchorage per Specification Section 05 50 00.
- B. Field touch-up of galvanized surfaces.
- 1. Zinc-rich primer.
    - a. One (1) coat, 3.0 mils, ZRC by ZRC Products.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specification Sections and ensure that equipment is ready and safe for energization.
- B. Install equipment in accordance with the requirements of:
  - 1. NFPA 70.
  - 2. IEEE C2.
  - 3. The manufacturer's instructions.
- C. In general, conduit routing is not shown on the Drawings.
  - 1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.
  - 2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.
- D. When complete branch circuiting is not shown on the Drawings:
  - 1. A homerun indicating panelboard name and circuit number will be shown and the circuit number will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.
  - 2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.
  - 3. The indicated home run conduit and conductor size shall be used for the entire branch circuit.
  - 4. See Specification Section 26 05 19 for combining multiple branch circuits in a common conduit.
- E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70.
- F. Install equipment plumb, square and true with construction features and securely fastened.
- G. Install electrical equipment, including pull and junction boxes, minimum of 6 IN from process, gas, air and water piping and equipment.
- H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.
- I. Device Mounting Schedule:

1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:
  - a. Light switch (to center): 46 IN.
  - b. Receptacle in architecturally finished areas (to center): 18 IN.
  - c. Receptacle on exterior wall of building (to center): 18 IN.
  - d. Receptacle in non-architecturally finished areas (to center): 46 IN.
  - e. Safety switch (to center of operating handle): 54 IN.
  - f. Separately mounted motor starter (to center of operating handle): 54 IN.
  - g. Pushbutton or selector switch control station (to center): 46 IN.
  - h. Panelboard (to top): 72 IN.
- J. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.
  1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 IN in equipment location with the Owner's approval.
- K. Provide electrical equipment support system per the following area designations:
  1. Damp areas:
    - a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
    - b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
  2. Wet areas:
    - a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
    - b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
- L. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.
  1. See Specification Section 05 50 00.
  2. Do not cut, or weld to, building structural members.
  3. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.
- M. Provide corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas.
- N. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.
- O. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.
- P. Do not use materials that may cause the walls or roof of a building to discolor or rust.
- Q. Provide field markings and/or documentation of available short-circuit current (available fault current) and related information for equipment as required by the NFPA 70 and other applicable codes.
- R. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
  1. Determine the SCCR rating by one of the following methods:
    - a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
    - b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.

- c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
2. The source equipment is the switchboard, panelboard, motor controls or similar equipment where the equipment or control panel circuit originates.
3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

### **3.2 FIELD QUALITY CONTROL**

- A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.
  1. See Specification Section 01 73 20 for openings and penetrations in structures.
- B. Replace equipment and systems found inoperative or defective and re-test.
- C. The protective coating integrity of support structures and equipment enclosures shall be maintained.
  1. Repair galvanized components utilizing a zinc rich paint.
  2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
  3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
  4. Repair surfaces which will be inaccessible after installation prior to installation.
  5. See Specification Section 26 05 33 for requirements for conduits and associated accessories.
- D. Replace nameplates damaged during installation.

### **3.3 DEMONSTRATION**

- A. Demonstrate equipment in accordance with Specification Section 01 75 00.

## **END OF SECTION**

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**SECTION 26 05 19**  
**WIRE AND CABLE - 600 VOLT AND BELOW**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Building wire.
    - b. Power cable.
    - c. Control cable.
    - d. Instrumentation cable.
    - e. Wire connectors.
    - f. Insulating tape.
    - g. Pulling lubricant.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 26 05 00 - Electrical: Basic Requirements.
  - 4. Section 26 08 13 - Acceptance Testing.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Insulated Cable Engineers Association (ICEA):
    - a. S-58-679, Standard for Control Cable Conductor Identification.
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. ICS 4, Industrial Control and Systems: Terminal Blocks.
  - 3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
    - a. WC 57/S-73-532, Standard for Control Cables.
    - b. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
  - 4. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
    - b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
  - 5. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
    - a. 568, Commercial Building Telecommunications Cabling Standard.
  - 6. Underwriters Laboratories, Inc. (UL):
    - a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
    - b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.
    - c. 467, Standard for Safety Grounding and Bonding Equipment.
    - d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.
    - e. 486C, Standard for Safety Splicing Wire Connections.
    - f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
    - g. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
    - h. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.
    - i. 2250, Standard for Safety Instrumentation Tray Cable.

### 1.3 DEFINITIONS

- A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- B. Instrumentation Cable:
  - 1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
  - 2. The following are specific types of instrumentation cables:
    - a. Analog signal cable:
      - 1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 VDC) signals, using No. 16 AWG and smaller conductors.
      - 2) Commonly used types are defined in the following:
        - a) STP: Shielded Twisted pair.
        - b) TST: Twisted shielded triad.
    - b. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc.
- C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger.
- D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, No. 12 or No. 10 AWG.
- E. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
      - 1) Wire connectors.
      - 2) Insulating tape.
      - 3) Cable lubricant.
    - b. See Specification Section 26 05 00 for additional requirements.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 26 05 00.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Building wire, power and control cable:
    - a. Aetna Insulated Wire.
    - b. Alphawire.
    - c. Cerrowire.
    - d. Encore Wire Corporation.
    - e. General Cable.
    - f. Okonite Company.
    - g. Southwire Company.
  - 2. Instrumentation cable:
    - a. Analog cable:
      - 1) Alphawire.
      - 2) Belden Inc.



- 3) General Cable.
- 3. Wire connectors:
  - a. Burndy Corporation.
  - b. Buchanan.
  - c. Ideal.
  - d. Ilsco.
  - e. 3M Co.
  - f. Teledyne Penn Union.
  - g. Thomas and Betts.
  - h. Phoenix Contact.
- 4. Insulating and color coding tape:
  - a. 3M Co.
  - b. Plymouth Bishop Tapes.
  - c. Red Seal Electric Co.

B. Submit request for substitution in accordance with Specification Section 00 72 13.

## 2.2 MANUFACTURED UNITS

- A. Building Wire:
  - 1. Conductor shall be copper with 600 V rated insulation.
  - 2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits which may be stranded or solid.
  - 3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  - 4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
  - 5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.
- B. Power Cable:
  - 1. Conductor shall be copper with 600 V rated insulation.
  - 2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  - 3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
  - 4. Number of conductors as required, including a bare ground conductor.
  - 5. Individual conductor color coding:
    - a. ICEA S-58-679, Method 4.
    - b. See PART 3 of this Specification Section for additional requirements.
  - 6. Conform to NFPA 70 Type TC.
- C. Control Cable:
  - 1. Conductor shall be copper with 600 V rated insulation.
  - 2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  - 3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
  - 4. Number of conductors as required, provided with or without bare ground conductor of the same AWG size.
    - a. When a bare ground conductor is not provided, an additional insulated conductor shall be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are equal).
  - 5. Individual conductor color coding:
    - a. ICEA S-58-679, Method 1, Table E-2.
    - b. See PART 3 of this Specification Section for additional requirements.
  - 6. Conform to NFPA 70 Type TC.
- D. Electrical Equipment Control Wire:

1. Conductor shall be copper with 600 V rated insulation.
  2. Conductors shall be stranded.
  3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  4. Conform to UL 44 for Type SIS insulation.
  5. Conform to UL 83 for Type MTW insulation.
- E. Instrumentation Cable:
1. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  2. Analog cable:
    - a. Tinned copper conductors.
    - b. 300 V or 600 V PVC insulation with PVC jacket.
    - c. Twisted with 100 PCT foil shield coverage with drain wire.
    - d. Six (6) twists per foot minimum.
    - e. Individual conductor color coding: ICEA S-58-679, Method 1, Table E-2.
    - f. Conform to UL 2250, UL 1581 and NFPA 70 Type ITC.
  3. Digital cable:
    - a. As recommended by equipment (e.g., PLC, RTU) manufacturer.
    - b. Horizontal voice and data cable:
      - 1) Category 6 per TIA/EIA/ANSI 568.
      - 2) Cable shall be label-verified.
      - 3) Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
      - 4) Conductors: No. 24 AWG solid untinned copper.
      - 5) Rated CMP per NFPA 70.
    - c. Conform to NFPA 262 and NFPA 70 Type ITC.
- F. Wire Connectors:
1. Twist/screw on type:
    - a. Insulated pressure or spring type solderless connector.
    - b. 600 V rated.
    - c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
    - d. Phase and neutral conductors: Conform to UL 486C.
  2. Compression and mechanical screw type:
    - a. 600 V rated.
    - b. Ground conductors: Conform to UL 467.
    - c. Phase and neutral conductors: Conform to UL 486A.
  3. Terminal block type:
    - a. High density, screw-post barrier-type with white center marker strip.
    - b. 600 V and ampere rating as required, for power circuits.
    - c. 600 V, 20 ampere rated for control circuits.
    - d. 300 V, 15 ampere rated for instrumentation circuits.
    - e. Conform to NEMA ICS 4 and UL 486A.
- G. Insulating and Color Coding Tape:
1. Pressure sensitive vinyl.
  2. Premium grade.
  3. Heat, cold, moisture, and sunlight resistant.
  4. Thickness, depending on use conditions: 7, 8.5, or 10 MIL.
  5. For cold weather or outdoor location, tape must also be all-weather.
  6. Color:
    - a. Insulating tape: Black.
    - b. Color coding tape: Fade-resistant color as specified herein.
  7. Comply with UL 510.

- H. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Permitted Usage of Insulation Types:
1. Type XHHW-2:
    - a. Building wire and power and control cable in non-architectural finished areas.
    - b. Building wire and power and control cable in conduit below grade.
  2. Type THHN/THWN and THHN/THWN-2:
    - a. Building wire and power and control cable No. 8 AWG and smaller in non-architectural finished areas.
  3. Type SIS and MTW:
    - a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.
- B. Conductor Size Limitations:
1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless otherwise indicated on the Drawings.
  2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.
  3. Instrumentation conductors shall not be smaller than No. 18 AWG unless otherwise indicated on the Drawings.
- C. Color Code All Wiring as Follows:
1. Building wire:

	240 V, 208 V, 240/120 V, 208/120 V	480 V, 480/277 V
Phase 1	Black	Brown
Phase 2	Red *	Orange
Phase 3	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

\* Orange when it is a high leg of a 120/240 V Delta system.

- a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.
- b. Conductors larger than No. 6 AWG:
  - 1) Insulated phase and neutral conductors shall be identified by one (1) of the following methods:
    - a) Continuous colored outer finish along its entire length.
    - b) 3 IN of colored tape applied at the termination.
  - 2) Insulated grounding conductor shall be identified by one (1) of the following methods:
    - a) Continuous green outer finish along its entire length.
    - b) Stripping the insulation from the entire exposed length.
    - c) Using green tape to cover the entire exposed length.
  - 3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.
2. Power cables ICEA S-58-679, Method 4 with:
  - a. Phase and neutral conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.

- b. Ground conductor: Bare.
- 3. Control cables ICEA S-58-679, Method 1, Table E-2:
  - a. When a bare ground is not provided, one (1) of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.
  - b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
- D. Install all wiring in raceway unless otherwise indicated on the Drawings.
- E. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:
  - 1. Where specifically indicated on the Drawings.
  - 2. Where field conditions dictate and written permission is obtained from the Owner.
  - 3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.
    - a. The combinations shall comply with the following:
      - 1) 12 VDC, 24 VDC and 48 VDC may be combined.
      - 2) 125 VDC shall be isolated from all other AC and DC circuits.
      - 3) AC control circuits shall be isolated from all DC circuits.
  - 4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
    - a. The combinations shall comply with the following:
      - 1) Analog signal circuits may be combined.
      - 2) Digital signal circuits may be combined but isolated from analog signal circuits.
    - b. Multiple branch circuits for similar loads may be combined in a common raceway, such as multiple lighting circuits or multiple receptacle circuits or other 120Vac circuits. Do not combine lighting and receptacle circuits.
    - c. Do not combine control device circuits with lighting or receptacle circuits.
    - d. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NFPA 70, including but not limited to:
      - 1) Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway.
      - 2) The neutral conductors may not be shared.
      - 3) Up sizing raceway size for the size and quantity of conductors.
- F. Ground the drain wire of shielded instrumentation cables at one (1) end only.
  - 1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g., field mounted instrument).
- G. Splices and terminations for the following circuit types shall be made in the indicated enclosure type using the indicated method.
  - 1. Feeder and branch power circuits:
    - a. Device outlet boxes:
      - 1) Twist/screw on type connectors.
    - b. Junction and pull boxes and wireways:
      - 1) Twist/screw on type connectors for use on No. 8 and smaller wire.
      - 2) Compression, mechanical screw or terminal block or terminal strip type connectors for use on No. 6 AWG and larger wire.
    - c. Motor terminal boxes:
      - 1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.
      - 2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger wire.
    - d. Manholes or handholes:

- 1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and smaller wire.
    - 2) Watertight compression or mechanical screw type connectors for use on No. 6 AWG and larger wire.
  2. Control circuits:
    - a. Junction and pull boxes: Terminal block type connector.
    - b. Manholes or handholes: Twist/screw on type connectors pre-filled with epoxy.
    - c. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.
  3. Instrumentation circuits can be spliced where field conditions dictate and written permission is obtained from the Owner.
    - a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
    - b. Junction and pull boxes: Terminal block type connector.
    - c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor.
  4. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.
- H. Insulating Tape Usage:
1. For insulating connections of No. 8 AWG wire and smaller: 7 MIL vinyl tape.
  2. For insulating splices and taps of No. 6 AWG wire or larger: 10 MIL vinyl tape.
  3. For insulating connections made in cold weather or in outdoor locations: 8.5 MIL, all weather vinyl tape.
- I. Color Coding Tape Usage: For color coding of conductors.

### **3.2 FIELD QUALITY CONTROL**

- A. Acceptance Testing:
1. See Specification Section 26 08 13.

## **END OF SECTION**

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## **SECTION 26 05 26**

### **GROUNDING AND BONDING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for grounding and bonding system(s).
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 26 05 00 - Electrical: Basic Requirements.
  - 4. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
  - 5. Section 26 05 33 - Raceways and Boxes.
  - 6. Section 26 08 13 - Acceptance Testing.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
  - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
  - 3. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 4. Underwriters Laboratories, Inc. (UL):
    - a. 467, Grounding and Bonding Equipment.
- B. Assure ground continuity is continuous throughout the entire Project.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data.
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
      - 1) Grounding clamps, terminals and connectors.
      - 2) Exothermic welding system.
    - b. See Specification Section 26 05 00 for additional requirements.

#### **PART 2 - PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Ground rods and bars and grounding clamps, connectors and terminals:
    - a. Erico Products, Inc.
    - b. Harger Lightning & Grounding.
    - c. Heary Brothers.
    - d. Hubbell - Burndy.
    - e. Robbins Lightning Protection.

- f. Thomas & Betts - Blackburn.
- g. Thompson Lightning Protection.
- 2. Exothermic weld connections:
  - a. Erico Products Inc., Cadweld.
  - b. Harger Lightning & Grounding - Ultraweld.
  - c. Hubbell - Burndy (Thermoweld).
  - d. Thomas & Betts - Furseweld.

## 2.2 COMPONENTS

- A. Wire and Cable:
  - 1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.
  - 2. Insulated conductors: Color coded green, per Specification Section 26 05 19.
- B. Conduit: As specified in Specification Section 26 05 33.
- C. Ground Bars:
  - 1. Solid copper:
    - a. 1/4 IN thick.
    - b. 2 or 4 IN wide.
    - c. 24 IN long minimum in main service entrance electrical rooms, 12 IN long elsewhere.
  - 2. Predrilled grounding lug mounting holes.
  - 3. Stainless steel or galvanized steel mounting brackets.
  - 4. Insulated standoffs.
- D. Ground Rods:
  - 1. 3/4 IN x 10 FT, or as indicated on the Drawings.
  - 2. Copper-clad:
    - a. 10 MIL minimum uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
    - b. Corrosion resistant bond between the copper and steel.
    - c. Hard drawn for a scar-resistant surface.
- E. Grounding Clamps, Connectors and Terminals:
  - 1. Mechanical type:
    - a. Standards: UL 467.
    - b. High copper alloy content.
  - 2. Compression type for interior locations:
    - a. Standards: UL 467.
    - b. High copper alloy content.
    - c. Non-reversible.
    - d. Terminals for connection to bus bars shall have two bolt holes.
  - 3. Compression type suitable for direct burial in earth or concrete:
    - a. Standards: UL 467, IEEE 837.
    - b. High copper alloy content.
    - c. Non-reversible.
    - d. Factory filled with oxide inhibiting compound.
- F. Exothermic Weld Connections:
  - 1. Copper oxide reduction by aluminum process.
  - 2. Molds properly sized for each application.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General:
  - 1. Install products in accordance with manufacturer's instructions.



2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.
  3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections. After connection, apply manufacturers approved touch-up paint to protect metallic surface from corrosion.
  4. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves and install sleeve per Specification Section 01 73 20.
    - a. Seal the sleeve interior to stop water penetration.
  5. Do not splice grounding electrode conductors except at ground rods.
  6. Install ground rods and grounding electrode conductors in undisturbed, firm soil.
    - a. Provide excavation required for installation of ground rods and conductors.
    - b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
    - c. Unless otherwise specified, connect conductors to ground rods with compression type connectors or exothermic weld.
    - d. Provide sufficient slack in conductor to prevent conductor breakage during backfill or due to ground movement.
    - e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
  7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.
- B. Grounding Electrode System:
1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.
    - a. All grounding electrode conductors terminate on a main ground bar located adjacent to the service entrance equipment.
  2. Grounding electrode conductor terminations:
    - a. Ground bars mounted on wall: Use a two-hole compression type conductor terminal and bolt it to the ground bar with two bolts.
    - b. Ground bars in electrical equipment: Use compression type conductor terminal and bolt it to the ground bar or manufacture's provided mechanical type termination device.
    - c. Piping systems: Use mechanical type connections.
    - d. Building steel, below grade and encased in concrete: Use compression type connector or exothermic weld.
    - e. Building steel, above grade: Use a two-hole compression type conductor terminal and bolt to the steel with two bolts or exothermic weld.
    - f. Ground rod: Compression type or exothermic weld, unless otherwise specified.
    - g. At all above grade terminations, the conductors shall be labeled.
  3. Ground ring grounding system:
    - a. Ground ring consists of ground rods and a conductor looped around the structure.
    - b. Placed at a minimum of 10 FT from the structure foundation and 2 FT-6 IN below grade.
    - c. Provide a minimum of four (4) ground rods placed at the corners of the structure and additional rods so that the maximum distance between ground rods does not exceed 50 FT.
    - d. Building/Structure grounding:
      - 1) Bond building/structure metal support columns to the ground ring at all corners of the structure.
    - e. Grounding conductor: Bare conductor, size as indicated on the Drawings.
- C. Supplemental Grounding Electrode:
1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors whether or not shown on the Drawings.
    - a. See Grounding Electrode System paragraph for conductor termination requirements.
  2. Metal light poles:

- a. Connect metal pole and pole base reinforcing steel to a ground rod.
  - b. Grounding conductor: Bare #6 AWG minimum.
- 3. Equipment support rack and pedestals mounted outdoors:
  - a. Connect metallic structure to a ground rod.
  - b. Grounding conductor: #6 AWG minimum.
- D. Raceway Bonding/Grounding:
  - 1. Install all metallic raceway so that it is electrically continuous.
  - 2. Provide an equipment grounding conductor in all raceways with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
  - 3. NFPA 70 required grounding bushings shall be of the insulating type.
  - 4. Provide double locknuts at all panels.
  - 5. Bond all conduits, at entrance and exit of equipment, to the equipment ground bus or lug.
  - 6. Provide bonding jumpers if conduits are installed in concentric knockouts.
  - 7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.
- E. Equipment Grounding:
  - 1. Ground all utilization equipment with an equipment grounding conductor.
- F. Handhole Grounding:
  - 1. Provide a ground rod and ground bar, when indicated or as needed, in each handhole with exposed metal parts.
    - a. Expose a minimum of 4 IN of the rod above the floor for field connections to the rod.
  - 2. Connect all exposed metal parts (e.g., conduits and cable racks) to the ground rod.

### **3.2 FIELD QUALITY CONTROL**

- A. Leave grounding system uncovered until observed by Owner.
- B. Acceptance testing:
  - 1. See Specification Section 26 08 13.

### **END OF SECTION**

## **SECTION 26 05 33**

### **RACEWAYS AND BOXES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Conduits.
    - b. Conduit fittings.
    - c. Conduit supports.
    - d. Wireways.
    - e. Outlet boxes.
    - f. Pull and junction boxes.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 26 05 00 - Electrical: Basic Requirements.
  - 4. Section 26 05 43 - Electrical: Exterior Underground.
  - 5. Section 26 27 26 - Wiring Devices.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Iron and Steel Institute (AISI).
  - 2. ASTM International (ASTM):
    - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - c. D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
  - 3. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit (IMC).
    - c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
    - d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
    - e. TC 14.AG, Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
    - f. TC 14.BG, Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
  - 4. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
    - a. C80.1, Electric Rigid Steel Conduit (ERSC).
    - b. C80.3, Steel Electrical Metallic Tubing (EMT).
    - c. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 5. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 6. Underwriters Laboratories, Inc. (UL):
    - a. 1, Standard for Flexible Metal Conduit.
    - b. 6, Standard for Electrical Rigid Metal Conduit - Steel.
    - c. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.

- d. 360, Standard for Liquid-Tight Flexible Steel Conduit.
- e. 467, Grounding and Bonding Equipment.
- f. 514A, Metallic Outlet Boxes.
- g. 514B, Conduit, Tubing, and Cable Fittings.
- h. 651, Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
- i. 797, Electrical Metallic Tubing - Steel.
- j. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
- k. 886, Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
- l. 2420, Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- m. 2515, Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
      - 1) Conduit fittings.
      - 2) Support systems.
    - b. See Specification Section 26 05 00 for additional requirements.
  - 3. Fabrication and/or layout drawings:
    - a. Identify dimensional size of pull and junction boxes to be used.

### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. See Specification Section 26 05 00.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Rigid metal conduits and electrical metallic tubing:
    - a. Allied Tube and Conduit Corporation.
    - b. Triangle PWC Inc.
    - c. Western Tube and Conduit Corporation.
    - d. Wheatland Tube Company.
  - 2. Rigid nonmetallic conduit:
    - a. Prime Conduit (Carlon).
    - b. Cantex.
    - c. Osburn Associates.
    - d. Champion Fiberglass.
    - e. United Fiberglass of America, Inc.
  - 3. Flexible conduit:
    - a. AFC Cable Systems.
    - b. Anamet, Inc.
    - c. Electri-Flex.
    - d. International Metal Hose Company.
    - e. Southwire Company.
  - 4. Wireway:
    - a. Hoffman Engineering Company.
    - b. Wiegmann.
    - c. Square D.

5. Conduit fittings and accessories:
  - a. Appleton Electric Co.
  - b. Carlon.
  - c. Cantex.
  - d. Crouse-Hinds.
  - e. Killark.
  - f. Osburn Associates.
  - g. OZ Gedney Company.
  - h. RACO.
  - i. Steel City.
  - j. Thomas & Betts.
6. Support systems:
  - a. Unistrut Building Systems.
  - b. Eaton B-Line.
  - c. Kindorf.
  - d. Minerallac Fastening Systems.
  - e. Caddy.
  - f. Thomas & Betts Superstrut.
7. Outlet, pull and junction boxes:
  - a. Appleton Electric Co.
  - b. Eaton Crouse-Hinds.
  - c. Killark.
  - d. O-Z/Gedney.
  - e. Thomas & Betts Steel City.
  - f. Raco.
  - g. Bell.
  - h. Hoffman Engineering Co.
  - i. Wiegmann.
  - j. Eaton B-Line.
  - k. Adalet.
  - l. Rittal.
  - m. Stahlin.

B. Submit request for substitution in accordance with Specification Section 00 72 13.

## **2.2 RIGID METAL CONDUITS**

- A. Rigid Galvanized Steel Conduit (RGS):
  1. Mild steel with continuous welded seam.
  2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
  3. Threads galvanized after cutting.
  4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
  5. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6.

## **2.3 RIGID NONMETALLIC CONDUIT**

- A. Schedules 40 (PVC-40) and 80 (PVC-80):
  1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
  2. Rated for direct sunlight exposure.
  3. Fire retardant and low smoke emission.
  4. Shall be suitable for use with 90 DEGC wire and shall be marked "maximum 90 DEGC".
  5. Standards: NFPA 70 Type PVC, NEMA TC 2, UL 651.

## **2.4 FLEXIBLE CONDUIT**

- A. Flexible Galvanized Steel Conduit (FLEX):

1. Formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
  2. Standard: NFPA 70 Type FMC, UL 1.
- B. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
  2. Extruded PVC outer jacket positively locked to the steel core.
  3. Liquid and vaportight.
  4. Standard: NFPA 70 Type LFMC, UL 360.

## **2.5 WIREWAY**

- A. General:
1. Suitable for lay-in conductors.
  2. Designed for continuous grounding.
  3. Covers:
    - a. Hinged or removable in accessible areas.
    - b. Non-removable when passing through partitions.
  4. Finish: Rust inhibiting primer and manufacturer's standard paint inside and out except for stainless steel type.
  5. Standards: UL 870, NEMA 250.
- B. Raintight (NEMA 3R) Wiring Trough:
1. 14 or 16 GA galvanized steel without knockouts.
  2. Cover: Non-gasketed and held in place by captive screws.

## **2.6 CONDUIT FITTINGS AND ACCESSORIES**

- A. Fittings for Use with RGS:
1. Locknuts:
    - a. Threaded steel or malleable iron.
    - b. Gasketed or non-gasketed.
    - c. Grounding or non-grounding type.
  2. Bushings:
    - a. Threaded, insulated metallic.
    - b. Grounding or non-grounding type.
  3. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
  4. Couplings:
    - a. Threaded straight type: Same material and finish as the conduit with which they are used on.
    - b. Threadless type: Gland compression or self-threading type, concrete tight.
  5. Unions: Threaded galvanized steel or zinc plated malleable iron.
  6. Conduit bodies (ells and tees):
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    - b. Standard and mogul size.
    - c. Cover:
      - 1) Clip-on type with stainless steel screws.
      - 2) Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.
  7. Conduit bodies (round):
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    - b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron or cast copper free aluminum.
  8. Sealing fittings:
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    - b. Standard and mogul size.
    - c. With or without drain and breather.

- d. Fiber and sealing compound: UL listed for use with the sealing fitting.
- 9. Service entrance head:
  - a. Malleable iron, galvanized steel or copper free aluminum.
  - b. Insulated knockout cover for use with a variety of sizes and number of conductors.
- 10. Expansion couplings:
  - a. 2 IN nominal straight-line conduit movement in either direction.
  - b. Galvanized steel with insulated bushing.
  - c. Gasketed for wet locations.
  - d. Internally or externally grounded.
- 11. Expansion/deflection couplings:
  - a. 3/4 IN nominal straight-line conduit movement in either direction.
  - b. 30-degree nominal deflection from the normal in all directions.
  - c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
  - d. Internally or externally grounded.
  - e. Watertight, raintight and concrete tight.
- 12. Standards: UL 467, UL 514B, UL 886.
- B. Fittings for Use with FLEX:
  - 1. Connector:
    - a. Zinc plated malleable iron.
    - b. Squeeze or clamp-type.
  - 2. Standard: UL 514B.
- C. Fittings for Use with FLEX-LT:
  - 1. Connector:
    - a. Straight or angle type.
    - b. Metal construction, insulated and gasketed.
    - c. Composed of locknut, grounding ferrule and gland compression nut.
    - d. Liquid tight.
  - 2. Standards: UL 467, UL 514B.
- D. Fittings for Use with Rigid Nonmetallic PVC Conduit:
  - 1. Coupling, adapters and conduit bodies:
    - a. Same material, thickness, and construction as the conduits with which they are used.
    - b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
    - c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
  - 2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
  - 3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.
- E. Fittings for Use with Rigid Nonmetallic Fiberglass Conduit:
  - 1. Coupling and adapters shall be of the same material, thickness, and construction as the conduit.
  - 2. Epoxy adhesive for joining conduits and fittings shall be supplied by the same manufacturer as the conduit and fittings and shall provide a concrete and water tight connection.
  - 3. Standard: NFPA 70 Type RTRC, NEMA TC14.AG, NEMA TC14.BG, UL 2420, UL 2415.
- F. Weather and Corrosion Protection Tape:
  - 1. PVC based tape, 10 mils thick.
  - 2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
  - 3. Used with appropriate pipe primer.

## 2.7 ALL RACEWAY AND FITTINGS

- A. Mark Products:
  - 1. Identify the nominal trade size on the product.
  - 2. Stamp with the name or trademark of the manufacturer.

## **2.8 OUTLET BOXES**

- A. Metallic Outlet Boxes:
  - 1. Hot-dip galvanized steel.
  - 2. Conduit knockouts and grounding pigtail.
  - 3. Styles:
    - a. 2 IN x 3 IN rectangle.
    - b. 4 IN square.
    - c. 4 IN octagon.
    - d. Masonry/tile.
  - 4. Accessories:
    - a. Flat blank cover plates.
    - b. Barriers.
    - c. Extension, plaster or tile rings.
    - d. Box supporting brackets in stud walls.
    - e. Adjustable bar hangers.
  - 5. Standards: NEMA/ANSI OS 1, UL 514A.
- B. Cast Outlet Boxes:
  - 1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish.
  - 2. Threaded hubs and grounding screw.
  - 3. Styles:
    - a. "FS" or "FD".
    - b. "Bell".
    - c. Single or multiple gang and tandem.
    - d. "EDS" or "EFS" for hazardous locations.
  - 4. Accessories: 40 MIL PVC exterior coating and 2 MIL urethane interior coating.
  - 5. Standards: UL 514A, UL 886.
- C. See Specification Section 26 27 26 for wiring devices, wallplates and coverplates.

## **2.9 PULL AND JUNCTION BOXES**

- A. NEMA 4 Rated:
  - 1. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
  - 2. Seams continuously welded and ground smooth.
  - 3. No knockouts.
  - 4. External mounting flanges.
  - 5. Hinged or non-hinged cover held closed with stainless steel screws and clamps.
  - 6. Cover with oil resistant gasket.
- B. Miscellaneous Accessories:
  - 1. Rigid handles for covers larger than 9 SQFT or heavier than 25 LBS.
  - 2. Split covers when heavier than 25 LBS.
  - 3. Weldnuts for mounting optional panels and terminal kits.
  - 4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.
- C. Standards: NEMA 250, UL 50.

## **2.10 SUPPORT SYSTEMS**

- A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:
  - 1. Material requirements:
    - a. Galvanized steel: ASTM A123/A123M or ASTM A153/A153M.
    - b. Stainless steel: AISI Type 316.
- B. Single Conduit and Outlet Box Support Fasteners:
  - 1. Material requirements:
    - a. Zinc plated steel.



- b. Stainless steel.
- c. Malleable iron.
- d. Steel protected with zinc phosphate and oil finish.

## **2.11 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS**

- A. Sleeves, smoke and fire stop fitting through walls and floors:
  - 1. See Specification Section 01 73 20.

## **PART 3 - EXECUTION**

### **3.1 RACEWAY INSTALLATION - GENERAL**

- A. Shall be in accordance with the requirements of:
  - 1. NFPA 70.
  - 2. Manufacturer instructions.
- B. Size of Raceways:
  - 1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
  - 2. Unless specifically indicated otherwise, the minimum raceway size shall be:
    - a. Conduit: 3/4 IN.
    - b. Wireway: 2-1/2 IN x 2-1/2 IN.
- C. Field Bending and Cutting of Conduits:
  - 1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
  - 2. Do not reduce the internal diameter of the conduit when making conduit bends.
  - 3. Prepare tools and equipment to prevent damage to the PVC coating.
  - 4. Degrease threads after threading and apply a zinc rich paint.
  - 5. Debur interior and exterior after cutting.
- D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
- E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
  - 1. Repair galvanized components utilizing a zinc rich paint.
  - 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
  - 3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape.
    - a. Total nominal thickness: 40 MIL.
  - 4. Repair surfaces which will be inaccessible after installation prior to installation.
- F. Remove moisture and debris from conduit before wire is pulled into place.
  - 1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to remove obstructions.
  - 2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
  - 3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.
- G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.
- H. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.

- I. Fill openings in walls, floors, and ceilings and finish flush with surface.
  - 1. See Specification Section 01 73 20.

### **3.2 RACEWAY ROUTING**

- A. Raceways shall be routed in the field unless otherwise indicated.
  - 1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
  - 2. Run in straight lines parallel to or at right angles to building lines.
  - 3. Do not route conduits:
    - a. Through areas of high ambient temperature or radiant heat.
    - b. In suspended concrete slabs.
    - c. In concrete members including slabs, slabs on grade, beams, walls, and columns unless specifically located and detailed on structural Drawings.
  - 4. Locate sleeves or conduits penetrating floors, walls, and beams so as not to significantly impair the strength of the construction. Do not place conduit penetrations in columns.
  - 5. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
  - 6. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 DEG of bends in the conduit run or in long straight runs to limit pulling tensions.
- B. All conduits within a structure shall be installed exposed except as follows:
  - 1. As indicated on the Drawings.
  - 2. Embedded in floor slabs or buried under floor slabs where shown on the Contract Drawings or with the Owners permission.
- C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 FT:
  - 1. Between instrumentation and telecommunication: 1 IN.
  - 2. Between instrumentation and 125 V, 48 V and 24 VDC, 2 IN.
  - 3. Between instrumentation and 600 V and less AC power or control: 6 IN.
  - 4. Between instrumentation and greater than 600 VAC power: 12 IN.
  - 5. Between telecommunication and 125 V, 48 V and 24 VDC, 2 IN.
  - 6. Between telecommunication and 600 V and less AC power or control: 6 IN.
  - 7. Between telecommunication and greater than 600 VAC power: 12 IN.
  - 8. Between 125 V, 48 V and 24 VDC and 600 V and less AC power or control: 2 IN.
  - 9. Between 125 V, 48 V and 24 VDC and greater than 600 VAC power: 2 IN.
  - 10. Between 600 V and less AC and greater than 600 VAC: 2 IN.
  - 11. Between process, gas, air and water pipes: 6 IN.
- D. Conduits shall be installed to eliminate moisture pockets.
  - 1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.
- E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.
- F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.
- G. Provide all required openings in walls, floors, and ceilings for conduit penetration.
  - 1. See Specification Section 01 73 20.

### **3.3 RACEWAY APPLICATIONS**

- A. Permitted Raceway Types per Wire or Cable Types:
  - 1. Power wire or cables: All raceway types.
  - 2. Control wire or cables: All raceway types.
  - 3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.
  - 4. Motor leads from a VFD: RGS, RAC or shielded VFD cables in all other raceways.

- 5. Telecommunication cables: All raceway types.
- B. Permitted Raceway Types Per Area Designations:
  - 1. Dry and Damp areas:
    - a. RGS.
  - 2. Wet areas:
    - a. RGS.
- C. Permitted Raceway Types Per Routing Locations:
  - 1. Embedded in poured concrete walls and floors:
    - a. PVC-40.
    - b. Fiberglass (above or below grade rated).
    - c. Fiberglass (above grade rated) when emerging from concrete into areas designated as wet, corrosive or highly corrosive.
  - 2. Beneath floor slab-on-grade:
    - a. PVC-40.
    - b. Fiberglass (above or below grade rated).
  - 3. Through floor penetrations, see Specification Section 01 73 20:
    - a. Fiberglass (above grade rated) in areas designated as wet, corrosive or highly corrosive.
  - 4. Direct buried conduits and ductbanks:
    - a. PVC-80.
    - b. Fiberglass (above or below grade rated).
    - c. 90 degree elbows for transitions to above grade:
      - 1) RGS.
      - 2) Fiberglass (above grade rated).
    - d. Long sweeping bends greater than 15 DEG:
      - 1) RGS.
      - 2) Fiberglass (above or below grade rated).
- D. FLEX conduits shall be installed for connections to light fixtures, HVAC equipment and other similar devices above the ceilings.
  - 1. The maximum length shall not exceed:
    - a. 6 FT to light fixtures.
    - b. 3 FT to all other equipment.
- E. FLEX-LT conduits shall be install as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.
  - 1. The maximum length shall not exceed:
    - a. 6 FT to light fixtures.
    - b. 3 FT to motors.
    - c. 2 FT to all other equipment.
- F. NEMA 3R Wiring Trough:
  - 1. Surface mounted in exterior locations.
- G. Underground Conduit: See Specification Section 26 05 43.

### **3.4 CONDUIT FITTINGS AND ACCESSORIES**

- A. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.
  - 1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.
- B. Install Expansion Fittings:
  - 1. Where conduits are exposed to the sun and conduit run is greater than 200 FT.
  - 2. Elsewhere as identified on the Drawings.
- C. Install Expansion/Deflection Fittings:
  - 1. Where conduits enter a structure.

- a. Except electrical manholes and handholes.
    - b. Except where the ductbank is tied to the structure with rebar.
  - 2. Where conduits span structural expansions joints.
  - 3. Elsewhere as identified on the Drawings.
- D. Threaded connections shall be made wrench-tight.
- E. Conduit joints shall be watertight:
- 1. Where subjected to possible submersion.
  - 2. In areas classified as wet.
  - 3. Underground.
- F. Terminate Conduits:
- 1. In metallic outlet boxes:
    - a. RGS:
      - 1) Conduit hub and locknut.
      - 2) Insulated bushing and two (2) locknuts.
      - 3) Use grounding type locknut or bushing when required by NFPA 70.
  - 2. In NEMA 4 rated enclosures:
    - a. Watertight, insulated and gasketed hub and locknut.
  - 3. When stubbed up through the floor into floor mount equipment:
    - a. With an insulated grounding bushing on metallic conduits.
    - b. With end bells on nonmetallic conduits.
- G. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

### 3.5 CONDUIT SUPPORT

- A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
- 1. Damp or wet areas:
    - a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit clamps.
    - b. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
  - 2. Conduit type shall be compatible with the support system material.
    - a. Galvanized steel system may be used with RGS.
    - b. Stainless steel system may be used with RGS.
    - c. Fiberglass system may be used with PVC-40 and PVC-80.
- B. Permitted single conduit support fasteners per area designations and conduit types:
- 1. Damp or wet areas:
    - a. Material: Zinc plated steel, stainless steel and malleable iron.
    - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
  - 2. Conduit type shall be compatible with the support fastener material.
    - a. Zinc plated steel, steel protected with zinc phosphate and oil finish and malleable iron fasteners may be used with RGS.
    - b. Stainless steel system may be used with RGS.
    - c. Nonmetallic fasteners may be used with PVC-40, PVC-80 and fiberglass.
- C. Conduit Support General Requirements:
- 1. Maximum spacing between conduit supports per NFPA 70.
  - 2. Support conduit from the building structure.
  - 3. Do not support conduit from process, gas, air or water piping; or from other conduits.

4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 LBS.
  - a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
  - b. Conduit hangers:
    - 1) Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.
  - c. Do not use suspended ceiling support systems to support raceways.
  - d. Hangers in metal roof decks:
    - 1) Utilize fender washers.
    - 2) Not extend above top of ribs.
    - 3) Not interfere with vapor barrier, insulation, or roofing.
5. Conduit support system fasteners:
  - a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
  - b. Do not use concrete nails and powder-driven fasteners.

### **3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION**

#### **A. General:**

1. Install products in accordance with manufacturer's instructions.
2. See Specification Section 26 05 00 and the Drawings for area classifications.
3. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
4. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.

#### **B. Outlet Boxes:**

1. Permitted uses of metallic outlet boxes:
  - a. Housing of wiring devices:
    - 1) Recessed in all stud framed walls and ceilings.
    - 2) Recessed in poured concrete, concrete block and brick walls of architecturally finished areas and exterior building walls.
  - b. Pull or junction box:
    - 1) Above gypsum wall board or acoustical tile ceilings.
    - 2) Above 10 FT in an architecturally finished area where there is no ceiling.
2. Permitted uses of cast outlet boxes:
  - a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet areas.
  - b. Pull and junction box surface mounted in non-architecturally finished dry, wet areas.
3. Mount device outlet boxes where indicated on the Drawings and at heights as scheduled in Specification Section 26 05 00.
4. Set device outlet boxes plumb and vertical to the floor.
5. Outlet boxes recessed in walls:
  - a. Install with appropriate stud wall support brackets or adjustable bar hangers so that they are flush with the face of the wall.
  - b. Locate in ungrouted cell of concrete block with bottom edge of box flush with bottom edge of block and flush with the face of the block.
6. Back-to-back are not permitted.
7. When an outlet box is connected to a PVC coated conduit, the box shall also be PVC coated.

#### **C. Pull and Junction Boxes:**

1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
  - a. Make covers of boxes accessible.
2. Permitted uses of NEMA 4 enclosure:
  - a. Pull or junction box surface mounted in areas designated as wet.

**END OF SECTION**

**SECTION 26 05 43**  
**ELECTRICAL - EXTERIOR UNDERGROUND**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Handhole.
    - b. Underground conduits.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 31 23 33 - Trenching, Backfilling and Compacting for Utilities.
  - 4. Division 03 - Concrete.
  - 5. Section 26 05 26 - Grounding.
  - 6. Section 26 05 33 - Raceways and Boxes.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Association of State Highway and Transportation Officials (AASHTO):
    - a. HB, Standard Specifications for Highway Bridges.
  - 2. ASTM International (ASTM):
    - a. A536, Standard Specification for Ductile Iron Castings.
  - 3. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 4. Society of Cable Telecommunications Engineers (SCTE):
    - a. 77, Specification for Underground Enclosure Integrity.

**1.3 DEFINITIONS**

- A. Direct-buried conduit(s):
  - 1. Individual (single) underground conduit.
  - 2. Multiple underground conduits, arranged in one or more planes, in a common trench.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
  - 3. Fabrication and/or layout drawings:
    - a. Provide dimensional drawings of each manhole indicating all specified accessories and conduit entry locations.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Prefabricated composite handholes:

- a. Armorcast Products Company.
    - b. Quazite Composolite.
    - c. Synertech.
  - 2. Handhole and ductbank accessories:
    - a. Cantex Inc.
    - b. Condux International, Inc.
    - c. Neenah.
    - d. Prime Conduit Inc.
    - e. Underground Devices, Inc.
    - f. Unistrut.
- B. Submit request for substitution in accordance with Specification Section 00 72 13.

## **2.2 HANDHOLES**

- A. Prefabricated Composite Material Handholes:
- 1. Handhole body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
  - 2. Minimum load ratings: SCTE 77 Tier 22.
  - 3. Open bottom.
  - 4. Stackable design as required for specified depth.
  - 5. Cover:
    - a. Engraved legend of "ELECTRIC" or "COMMUNICATIONS".
    - b. Non-gasketed bolt down with stainless steel penta head bolts.
    - c. Lay-in non-bolt down, when cover is over 100 LBS.
    - d. One or multiple sections so the maximum weight of a section is 125 LBS.
  - 6. Cover lifting hook: 24 IN minimum in length.

## **2.3 HANDHOLE ACCESSORIES**

- A. Cover and Frame:
- 1. AASHTO live load rating: H-20.
  - 2. Diameter: 30 IN.
  - 3. Cast the legend "ELECTRICAL" or "COMMUNICATIONS" into handhole covers.
- B. Ground Rods and Grounding Equipment: See Specification Section 26 05 26.

## **2.4 UNDERGROUND CONDUIT AND ACCESSORIES**

- A. Conduit: See Specification Section 26 05 33.

# **PART 3 - EXECUTION**

## **3.1 GENERAL**

- A. Drawings indicate the intended location of handholes and routing of direct buried conduit.
- 1. Field conditions may affect actual routing.
- B. Handhole Locations:
- 1. Approximately where shown on the Drawings.
  - 2. As required for pulling distances.
  - 3. As required to keep pulling tensions under allowable cable tensions.
  - 4. As required for number of bends in ductbank routing.
  - 5. Shall not be installed in a swale or ditch.
  - 6. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.
  - 7. Locations are to be approved by the Owner prior to excavation and placement or construction of handholes.
- C. Install products in accordance with manufacturer's instructions.



- D. Install handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.
- E. Comply with Specification Section 31 23 33 for trenching, backfilling and compacting.

### **3.2 HANDHOLES**

- A. Prefabricated Composite Material Handholes:
  - 1. For use in areas subjected to occasional non-deliberate heavy vehicular traffic.
  - 2. Place handhole on a foundation of compacted 1/4 to 1/2 IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than handholes footprint on all sides.
  - 3. Provide concrete encasement ring around handhole per manufacturers installation instructions (minimum of 10 IN wide x 12 IN deep).
  - 4. Install so that the surrounding grade is 1 IN lower than the top of the handhole.
  - 5. Size: As indicated on the Drawings or as required for the number and size of conduits.
  - 6. Provide cable rails and pulling eyes as needed.

### **3.3 UNDERGROUND CONDUITS**

- A. General Installation Requirements:
  - 1. Do not place concrete or soil until conduits have been observed by the OwnerFW.
  - 2. Ductbanks shall be sloped a minimum of 4 IN per 100 FT or as detailed on the Drawings.
    - a. Low points shall be at handholes.
  - 3. During construction and after conduit installation is complete, plug the ends of all conduits.
  - 4. Provide conduit supports and spacers.
    - a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:
      - 1) 1 IN and less: 3 FT.
      - 2) 1-1/4 to 3 IN: 5 FT.
      - 3) 3-1/2 to 6 IN: 7 FT.
    - b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:
      - 1) 1 IN and less: 10 FT.
      - 2) 1-1/4 to 2-1/2 IN: 14 FT.
      - 3) 3 IN and larger: 20 FT.
    - c. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.
  - 5. Stagger conduit joints at intervals of 6 IN vertically.
  - 6. Make conduit joints watertight and in accordance with manufacturer's recommendations.
  - 7. Accomplish changes in direction of runs exceeding a total of 15 DEG by long sweep bends having a minimum radius of 25 FT.
    - a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
  - 8. Furnish manufactured bends at end of runs.
    - a. Minimum radius of 18 IN for conduits less than 3 IN trade size and 36 IN for conduits 3 IN trade size and larger.
  - 9. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
  - 10. After the conduit run has been completed:
    - a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
      - 1) Test mandrel:
        - a) Length: Not less than 12 IN
        - b) Diameter: Approximately 1/4 IN less than the inside diameter of the conduit.
      - b. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.
  - 11. Pneumatic rodding may be used to draw in lead wire.

- a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
- b. Extend cord 3 FT beyond ends of conduit.
- 12. Transition from rigid nonmetallic conduit to rigid metallic conduit, per Specification Section 26 05 33, prior to entering a structure or going above ground.
  - a. Except rigid nonmetallic conduit may be extended directly to handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
  - b. Terminate rigid PVC conduits with end bells.
  - c. Terminate steel conduits with insulated bushings.
- 13. Place warning tape in trench directly over direct-buried conduit.
- 14. Placement of conduits stubbing into handholes shall be located to allow for proper bending radiuses of the cables.
- B. Direct-Buried Conduit(s):
  - 1. Install so that the top of the uppermost conduit, at any point:
    - a. Is not less than 30 IN below grade.
    - b. Is below pavement sub-grading.
  - 2. Provide a uniform minimum clearance of 2 IN between conduits or as required in Specification Section 26 05 33 for different cabling types.
    - a. Maintain the separation of multiple planes of conduits by one of the following methods:
      - 1) Install multilevel conduits with the use of conduit supports and separators to maintain the required separations, and backfill with flowable fill (100 PSI) or concrete per Specification Section 31 23 33.
      - 2) Install the multilevel conduits one level at a time.
        - a) Each level is backfilled with the appropriate amount of soil and compaction, per Specification Section 31 23 33, to maintain the required separations.

## **END OF SECTION**

## **SECTION 26 08 13**

### **ACCEPTANCE TESTING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Basic requirements for acceptance testing.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 01 61 03 - Equipment: Basic Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems.
    - b. 400.3, Guide for Partial Discharge Testing of Power Cable Systems in a Field Environment.
  - 2. International Electrical Testing Association (NETA):
    - a. ATS, Standard for Acceptance Testing Specifications for Electric Power Equipment and Systems.
  - 3. Nationally Recognized Testing Laboratory (NRTL).
  - 4. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
    - a. 455-78-B, Optical Fibres - PART 1-40: Measurement Methods and Test Procedures - Attenuation.
- B. Qualifications:
  - 1. Testing firm qualifications: See Specification Section 01 61 03.
  - 2. Field personnel:
    - a. See Specification Section 01 61 03.
    - b. As an alternative, supervising technician may be certified by the equipment manufacturer.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 01 61 03 for electrical equipment and connection testing plan submittal requirements.
- B. Informational Submittals:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Within two (2) weeks after successful completion of Demonstration Period (Commissioning Period):
    - a. Single report containing information including:
      - 1) Summary of Project.
      - 2) Information from pre-energization testing.
      - 3) See testing and monitoring reporting requirements in Specification Section 01 61 03.

## **PART 2 - PRODUCTS**

### **2.1 FACTORY QUALITY CONTROL**

- A. Provide Electrical equipment with all factory tests required by the applicable industry standards or NRTL.
- B. Factory testing will not be accepted in lieu of field acceptance testing requirements specified in this Specification Section and Specification Section 01 61 03.

## **PART 3 - EXECUTION**

### **3.1 FIELD QUALITY CONTROL**

- A. General:
  - 1. See Specification Section 01 61 03.
  - 2. Complete electrical testing in three (3) phases:
    - a. Pre-energization testing phase.
    - b. Equipment energized with no load.
    - c. Equipment energized under load.
  - 3. Perform testing in accordance with this Specification Section and NETA ATS.
- B. Electrical Equipment and Connections Testing Program:
  - 1. See Specification Section 01 61 03.
  - 2. See individual Division 26 Specification Sections for equipment specific testing requirements.
  - 3. Test all electrical equipment.
    - a. Perform all required NETA testing.

### **3.2 SPECIFIC EQUIPMENT TESTING REQUIREMENTS**

- A. Panelboards:
  - 1. Perform inspections and tests per NETA ATS 7.1.
  - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
- B. Cable - Low Voltage:
  - 1. Perform inspections and tests per NETA ATS 7.3.2.
- C. Low Voltage Molded Case Circuit Breakers:
  - 1. Perform inspections and tests per NETA ATS 7.6.1.1.
  - 2. Components:
    - a. Test all components per applicable paragraphs of this Specification Section and NETA ATS.
    - b. Thermal magnetic breakers: Visual and mechanical inspection per NETA ATS only.
    - c. Solid state trip type: Visual and mechanical inspection and electrical tests per NETA ATS.
  - 3. Record as-left settings.
- D. Grounding:
  - 1. Perform inspections and tests per NETA ATS 7.13.
  - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
- E. Motors:
  - 1. Perform inspections and tests per NETA ATS 7.15.
  - 2. See Specification Section 01 61 03.
- F. Motor Controllers:
  - 1. Perform inspections and tests per NETA ATS 7.16.

2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
- G. Control System Functional Test:
1. Perform test upon completion of equipment acceptance tests.
  2. The test is to prove the correct interaction of all sensing, processing and action devices.
  3. Develop a test plan and parameters for the purpose of evaluating the performance of the system.
  4. Perform the following tests:
    - a. Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.
    - b. Verify the correct operation of all sensing devices, alarms and indicating devices.

**END OF SECTION**

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**SECTION 26 09 16**  
**CONTROL EQUIPMENT ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Operator control devices (selector switches, pushbuttons, indicator lights, etc.).
  - 2. Control devices (timers, relays, contactors, etc.).
  - 3. Alarm Junction Boxes.
  - 4. Level sensors and float switches
  - 5. Time Switches
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 26 05 00 - Electrical: Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. ICS 2, Industrial Control and System Controllers, Contactors and Overload Relays Rated 600 Volts.
    - c. ICS 5, Control Circuit and Pilot Devices.
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. 508, Standard for Safety Industrial Control Equipment.
    - b. 508A, Standard for Safety Industrial Control Panels.
    - c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification:
  - 3. When components are used within equipment specified in another Section, submittal data for components specified herein shall be included with the submittal for the equipment the components are used in.
  - 4. See Section 26 05 00 for additional requirements.
  - 5. Submit fabrication and/or layout drawings.
    - a. Alarm Junction Boxes:
      - 1) Interior and exterior layout.
      - 2) Wiring/connection diagrams.
      - 3) Labeling
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
    - b. Content of Operation and Maintenance Manual:
      - 1) Product technical data of components used within alarm junction boxes.
      - 2) Operating instructions for time clocks.

3) Functional Test Report.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Pilot devices, relays, contactors, and termination equipment:

- a. Allen-Bradley.
- b. ATC Diversified Electronics.
- c. Automatic Switch Company (ASCO).
- d. c3controls.
- e. Eaton.
- f. General Electric Company.
- g. Idec.
- h. Phoenix Contact.
- i. Potter & Brumsfield.
- j. Schneider Electric.
- k. Siemens.
- l. Time Mark.

2. Photocells and time clocks:

- a. Grasslin.
- b. Tork.
- c. Intermatic.
- d. Paragon.

3. Float-Tilt Switches:

- a. Cynergy3, SLP submersible level probe.
- b. Anchor Scientific Inc.
- c. Consolidated Electric

4. Cable Suspended Portable Level Switches

- a. Gems Sensors
- b. SMD Fluid Controls

5. Enclosures:

- a. Hoffman Engineering Co.
- b. Wiegmann.
- c. Eaton B-Line.
- d. Adalet.
- e. Stahlin.

### **2.2 PILOT DEVICES**

A. General Requirements:

1. Standards: NEMA ICS 5, UL 508.
2. Heavy-duty NEMA 4/13 watertight/oiltight.
3. Heavy-duty NEMA 4/4X corrosion resistant.
4. Heavy-duty factory sealed, explosion-proof and dust ignition-proof (Class I and II).
5. Mounting hole: 30.5 MM.
6. Contact blocks: 10 amp, NEMA A600 rated, number as required to fulfill functions shown or specified.
7. Legend plate marked as indicated on Drawings or specified.

B. Selector Switches:

1. Two, three- or four-position rotary switch as required to fulfill functions shown or specified.
2. Maintained contact type.
3. Knob or lever type operators.



C. Pushbuttons:

1. Non-illuminated type:
  - a. Protective boot.
  - b. Momentary contact.
  - c. Standard flush and mushroom operators.
  - d. Green colored buttons for START or ON and red color for STOP or OFF.
  - e. Emergency stop pushbuttons: Mushroom head operator and maintained contact.
2. Illuminating type:
  - a. Protective boot.
  - b. Momentary contact.
  - c. Standard flush operator.
  - d. Serves as both pushbutton control and indicating light.
  - e. Green colored lenses: START or ON.
  - f. Red colored lenses: STOP or OFF.
  - g. Resistor-type full voltage light unit with lens and panel gasket.

D. Indicating Lights:

1. Allowing replacement of bulb without removal from control panel.
2. Lamp: LED, 120 V or 24 V as required.
3. Full voltage type.
4. Push-to-test indicating lights.
5. Plastic lens.
6. Color code lights as follows:
  - a. Green: ON or running.
  - b. Amber: Standby; auto mode; ready.
  - c. Red: OFF or stopped.

## 2.3 RELAYS

A. General Requirements:

1. Standards: NEMA ICS 5, UL 508.

B. Control Relays:

1. General purpose (ice cube) type:
  - a. Plug-in housing.
  - b. Clear polycarbonate dust cover with clip fastener.
  - c. Coil voltage: 120 VAC or as required.
  - d. Contacts:
    - 1) 10 amp continuous.
    - 2) Silver cadmium oxide.
    - 3) Minimum of 3 SPDT contacts.
  - e. Sockets: DIN rail mounted.
  - f. Internal neon or LED indicator is lit when coil is energized.
  - g. Manual operator switch.
2. Industrial type:
  - a. Coil voltage: 120 VAC or as required.
  - b. Contacts:
    - 1) 10 amp, NEMA A600 rated.
    - 2) Double break, silver alloy.
    - 3) Convertible from normally open to normally closed or vice versa, without removing any wiring.
    - 4) Expandable from 2 poles to 12 poles.
  - c. Provide contacts for all required control plus two spares.

C. Time Delay Relays:

1. General purpose type:
  - a. Timing modes: On and Off delay, interval, one shot and repeat cycle.

- b. Plug-in housing.
- c. Polycarbonate dust cover with clip fastener.
- d. Coil voltage: 120 VAC or as required.
- e. Contacts:
  - 1) 10 amp continuous.
  - 2) Silver cadmium oxide.
  - 3) Two normally open and two normally closed DPDT contacts.
- f. Sockets: DIN rail mounted.
- g. External timing adjustment knob.
- h. Timing ranges: 0.05 seconds to 16.65 HRS.
- i. Repeat accuracy: +1 PCT.
- 2. Solid State industrial type:
  - a. Timing modes: On and Off delay and repeat cycle.
  - b. Industrial housing.
  - c. Coil voltage: 120 VAC or as required.
  - d. Contacts:
    - 1) 5 amp, NEMA B150 rated.
    - 2) Silver alloy.
    - 3) Convertible On Delay and Off Delay contacts.
    - 4) One normally open and one normally closed timed contacts.
    - 5) One normally open and one normally closed instantaneous contacts.
  - e. Furnish with "on" and "timing out" indicators.
  - f. External timing adjustment knob.
  - g. Timing ranges: 0.05 seconds to 10 HRS.
  - h. Repeat accuracy: +1 PCT.
- 3. Mechanical industrial type:
  - a. Timing modes: On and Off delay.
  - b. Coil voltage: 120 VAC or as required.
  - c. Contacts:
    - 1) 10 amp, NEMA A600 rated.
    - 2) Double break, silver alloy.
    - 3) Convertible On Delay and Off Delay contacts.
    - 4) Convertible normally open and normally closed timed contacts.
    - 5) Convertible normally open instantaneous contacts.
  - d. External timing adjustment knob.
  - e. Timing ranges: 0.2 - 60 sec or 5 - 180 sec.
  - f. Repeat accuracy: Greater than +10 PCT.

## 2.4 CONTACTORS

- A. General Requirements:
  - 1. Standards: NEMA ICS 2, UL 508.
- B. Lighting and Remote Control Switches:
  - 1. Electrically operated, electrically held.
  - 2. Coil voltage: 120 VAC or as required.
  - 3. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
  - 4. Rated for ballasted lighting, tungsten and general use loads.
  - 5. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as specified.
  - 6. Auxiliary control relays, as indicated on Drawings or as specified.
  - 7. Auxiliary contacts, as indicated on Drawings or as specified.
- C. Definite Purpose:
  - 1. Coil voltage: 120 VAC or as required.
  - 2. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
  - 3. Resistive load and horsepower rated.

4. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as specified.
5. Auxiliary contacts, as indicated on Drawings or as specified.

## **2.5 PHOTOCELLS AND TIME CLOCKS**

- A. Photocells:
  1. Weatherproof enclosure.
  2. Adjustable turn-on range, initially set at 1.0 footcandles.
    - a. Turn-off level approximately three times turn-on.
  3. Provide time delay device to eliminate nuisance switching.
  4. Voltage, amperage and/or wattage ratings as required for the application.
- B. General Requirements for Time Clocks:
  1. Separate manual on-off operation without disturbing automatic settings.
  2. Enclosure:
    - a. NEMA 4 for indoor locations.
    - b. Stand alone or DIN rail for mounting in control panel.
    - c. NEMA 3R or 4 for exterior locations.
  3. Voltage, amperage and/or wattage ratings as required for the application.
- C. Electromechanical:
  1. 24 HR dial powered by a self-starting synchronous motor.
  2. Minimum of 16 HR carryover power utilizing a spring-driven reserve with automatic rewind or rechargeable battery.
  3. 96 semi-permanent attached trippers allowing min. on/off time of 15 minutes.
  4. Skipper feature to enable switching operation to skip any day or days of the week, and shall include wound carry over feature.

## **2.6 TERMINATION EQUIPMENT**

- A. General Requirements:
  1. Modular type with screw compression clamp.
  2. Screws: Stainless steel.
  3. Current bar: Nickel-plated copper alloy.
  4. Thermoplastic insulation rated for -40 to +90 DegC.
  5. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
  6. End sections and end stops at each end of terminal strip.
  7. Machine-printed terminal markers on both sides of block.
  8. Spacing: 6 mm.
  9. Wire size: 22-12 AWG.
  10. Rated voltage: 600 V.
  11. DIN rail mounting.
- B. Standard-type block:
  1. Rated current: 30 A.
  2. Color: Gray body.
- C. Bladed-type disconnect block:
  1. Terminal block with knife blade disconnect which connects or isolated the two sides of the block.
  2. Rated current: 10 A.
  3. Color:
    - a. Panel control voltage leaves enclosure - normal: Gray body, orange switch.
    - b. Foreign voltage entering enclosure: Orange body, orange switch.
- D. Grounded-type block:
  1. Electrically grounded to mounting rail.
  2. Terminal ground wires and analog cable shields.

3. Color: Green and yellow body.
- E. Fuse Holders:
  1. Blocks can be ganged for multi-pole operation.
  2. Spacing: 9.1 mm.
  3. Wire size: 30-12 AWG.
  4. Rated voltage: 300 V.
  5. Rated current: 12 A.
  6. Fuse size: 1/4 x 1-1/4.
  7. Blown fuse indication.
  8. DIN rail mounting.

## **2.7 FLOAT SWITCHES**

- A. Install floats per drawing details
- B. Float-Tilt Type Level Switches:
  1. Materials:
    - a. Float material: Polypropylene or Teflon coated type 316 stainless steel.
    - b. Cable jacket: PVC, neoprene.
    - c. Cable clamp: Polypropylene or 316 stainless steel.
  2. Design and fabrication:
    - a. Sealed mercury switch in float.
    - b. Provide switch complete with flexible electrical cables.
    - c. DPST contact rated at 4.5 amp at 120 Vac.
    - d. Direct acting float switch:
      - 1) Switch actuates on rising level.
      - 2) Switch deactuates when liquid falls 1 IN below actuation level.
    - e. Terminate cables in junction box.
    - f. Process temperature: 20-150 deg F.
- C. Cable Suspended Portable Level Switch:
  1. Float switches shall be single switch point liquid level probe suitable for use in water and designed to be suspended in the liquid by its cable.
  2. Float switches shall be normally open or normally closed configurable.
  3. Contacts shall be rated 25 VA, 50 volt AC/DC, 0.6 amp.
  4. Provide a suitable mounting bracket/clip to allow float switch to be suspended by the cord and allow adjustment over the entire range of operation.
  5. Float switches shall be installed so they are easily adjusted.

## **2.8 MISCELLANEOUS DEVICES**

- A. Run Time Meters:
  1. Six-digit wheels including a 1/10 digit.
  2. Non-reset type.
  3. Time range in hours.
  4. Automatic recycle at zero.
  5. Accuracy: 1 PCT.
  6. Sealed against dirt and moisture.
  7. Tamperproof.

## **2.9 ENCLOSURES**

- A. Alarm Junction Boxes:
  1. NEMA 12 enclosure:
    - a. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    - b. No knockouts.
    - c. External mounting flanges.

- d. Non-hinged stainless steel cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
- e. Flat door with oil resistant gasket.
- 2. Miscellaneous accessories:
  - a. Back plane mounting panels: Steel with white enamel finish or Type 304 stainless steel.
  - b. Interiors shall be white or light gray in color.
  - c. Weldnuts for mounting optional panels and terminal kits.
  - d. Ground bonding jumper from door, across hinge, to enclosure body.
- 3. Standards: NEMA 250, UL 508.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Float Switch Application:
  - 1. Backwash pump station: Float-tilt type
  - 2. Pavilion Tanks: Cable suspended portable type

**END OF SECTION**

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## **SECTION 26 24 16**

### **PANELBOARDS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Lighting and appliance panelboards.
  - 2. Power distribution panelboards.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 26 05 00 - Electrical: Basic Requirements.
  - 3. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. PB 1, Panelboards.
  - 2. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 3. Underwriters Laboratories, Inc. (UL):
    - a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
    - b. 67, Standard for Panelboards.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data.
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.
  - 3. Fabrication and/or layout drawings:
    - a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
  - 2. Panelboard schedules with as-built conditions.

#### **PART 2 - PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Eaton.
  - 2. General Electric Company.
  - 3. Square D Company.
  - 4. Siemens.

- B. Submit request for substitution in accordance with Specification Section 00 72 13.

## **2.2 MANUFACTURED UNITS**

- A. Standards: NEMA PB 1, NFPA 70, UL 50, UL 67.
- B. Ratings:
  - 1. Current, voltage, number of phases, number of wires as indicated on the Drawings.
  - 2. Panelboards rated 240 VAC or less: 10,000 amp minimum short circuit rating or as indicated in the schedule.
  - 3. Service Entrance Equipment rated when indicated on the Drawings.
- C. Construction:
  - 1. Interiors factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
  - 2. Multi-section panelboards: Feed-through or sub-feed lugs.
  - 3. Main lugs: Solderless type approved for copper and aluminum wire.
- D. Bus Bars:
  - 1. Main bus bars:
    - a. Plated aluminum or copper sized to limit temperature rise to a maximum of 65 DEGC above an ambient of 40 DEGC.
    - b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.
  - 2. Ground bus and isolated ground bus, when indicated on the Drawings: Solderless mechanical type connectors.
  - 3. Neutral bus bars: Insulated 100 PCT rated or 200 PCT rated, when indicated on the Drawings and with solderless mechanical type connectors.
- E. Enclosure:
  - 1. Boxes: Code gage galvanized steel, furnish without knockouts.
  - 2. Trim assembly: Code gage steel finished with rust inhibited primer and manufacturers standard paint inside and out.
  - 3. Lighting and appliance panelboard:
    - a. Trims supplied with hinged door over all circuit breaker handles.
    - b. Trims for surface mounted panelboards, same size as box.
    - c. Trims for flush mounted panelboards, overlap the box by 3/4 IN on all sides.
    - d. Doors lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike.
    - e. Nominal 20 IN wide and 5-3/4 IN deep with gutter space in accordance with NFPA 70.
    - f. Clear plastic cover for directory card mounted on the inside of each door.
  - 4. Power distribution panelboard:
    - a. Trims cover all live parts with switching device handles accessible.
    - b. Less than or equal to 12 IN deep with gutter space in accordance with NFPA 70.
    - c. Clear plastic cover for directory card mounted front of enclosure.
- F. Overcurrent and Short Circuit Protective Devices:
  - 1. Main overcurrent protective device:
    - a. Molded case circuit breaker.
  - 2. Branch overcurrent protective devices:
    - a. Mounted molded case circuit breaker.
  - 3. See Section 26 28 00 for overcurrent and short circuit protective device requirements.
  - 4. Factory installed.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install as indicated on the Drawings, in accordance with the NFPA 70, and in accordance with manufacturer's instructions.



- B. Support panelboard enclosures from wall studs or modular channels support structure, per Specification Section 26 05 00.
- C. Provide NEMA 4 rated enclosure as indicated on the Drawings.
- D. Provide each panelboard with a typed directory:
  - 1. Identify all circuit locations in each panelboard with the load type and location served.
  - 2. Mechanical equipment shall be identified by USER-furnished designation if different than designation indicated on the Drawings.
  - 3. Room names and numbers shall be final building room names and numbers as identified by the USER if different than designation indicated on the Drawings.

**END OF SECTION**

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**SECTION 26 24 19**  
**MOTOR CONTROL EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Separately mounted motor starters (including those supplied with equipment).
  - 2. Manual motor starters.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 26 05 00 - Electrical: Basic Requirements.
  - 4. Section 26 08 13 - Acceptance Testing.
  - 5. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
  - 6. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).
  - 7. Section 26 09 16 - Control Equipment Accessories.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. International Electrotechnical Commission (IEC).
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
    - b. ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.
  - 3. Underwriters Laboratories, Inc. (UL):
    - a. 508, Standard for Industrial Control Equipment.
    - b. 845, Motor Control Centers.
- B. Miscellaneous:
  - 1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Owner of any discrepancies.
  - 2. Verify the required instrumentation and control wiring for a complete system and notify Owner of any discrepancies.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.
  - 3. Fabrication and/or layout drawings:
    - a. Separately mounted combination starters:
      - 1) Unit ladder logic wiring for each unit depicting electrical wiring and identification of terminals where field devices or remote control signals are to be terminated as indicated on the Drawings and/or loop descriptions.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
    - b. Fabrication and/or layout drawings updated with as-built conditions.

- C. Informational Submittals:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Service equipment marking and documentation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Allen-Bradley.
  - 2. c3controls.
  - 3. Eaton.
  - 4. General Electric Company.
  - 5. Square D Company.
  - 6. Siemens.
- B. Submit request for substitution in accordance with Specification Section 00 72 13.

### **2.2 SEPARATELY MOUNTED COMBINATION STARTERS**

- A. Standards:
  - 1. NEMA 250, NEMA ICS 2.
  - 2. UL 508.
- B. Enclosure:
  - 1. NEMA 4 rated:
    - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
    - b. No knockouts, external mounting flanges, hinged and gasketed door.
- C. Operating Handle:
  - 1. With the door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
  - 2. Circuit breaker and MCP operators includes a separate TRIPPED position.
  - 3. Mechanical interlock to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism for use by authorized personnel.
  - 4. Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism for use by authorized personnel.
  - 5. Padlockable in the OFF position.
- D. External mounted overload relay pushbutton.
- E. Control Devices:
  - 1. Provide control devices as indicated on the Drawings per Specification Section 26 09 16.
  - 2. Devices will be accessible with the door closed.
- F. Control Power Transformer:
  - 1. 120V secondary.
  - 2. Fused on primary and secondary side.
  - 3. Sized for 140 PCT of required load.
- G. Fault Current Withstand Rating: Equal to the rating of the electrical gear from which it is fed.
- H. Motor Starters: See requirements within this Specification Section.
- I. Disconnect Switch, Overcurrent and Short Circuit Protective Devices:
  - 1. Motor circuit protector.
  - 2. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.

3. Factory installed.

## **2.3 MOTOR STARTERS**

- A. Standards:
  1. NEMA ICS 2.
  2. UL 508.
- B. Full Voltage Non-Reversing (FVNR) Magnetic Starters:
  1. NEMA full size rated contactor.
    - a. NEMA half sizes and IEC contactors are not permitted.
  2. Double-break silver alloy contacts.
  3. Overload relays:
    - a. Ambient insensitive, adjustable solid state type with phase loss protection, phase imbalance protection and manual reset.
  4. Interlock and auxiliary contacts, wired to terminal blocks:
    - a. Holding circuit contact, normally open.
    - b. Overload alarm contact, normally open.
    - c. Normally open auxiliary contact, for remote run status.
    - d. Additional field replaceable auxiliary contacts as required per the Sequence of Operation.
    - e. Two (2) additional normally open spare field replaceable auxiliary contacts.

## **2.4 MANUAL MOTOR STARTERS**

- A. Standards:
  1. NEMA 250, NEMA ICS 2.
  2. UL 508.
- B. Quick-make, quick-break toggle mechanism that is lockable in the OFF position.
- C. Types:
  1. Horsepower rated, for ON/OFF control.
  2. Horsepower rated, for ON/OFF control and thermal overload protection.
    - a. Switch to clearly indicate ON, OFF, and TRIPPED position.
- D. Voltage and current ratings and number of poles as required for the connected motor.
- E. Enclosures:
  1. NEMA 4 rated:
    - a. Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out or cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
    - b. No knockouts, external mounting flanges.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Install as indicated on the Drawings and in accordance with manufacturer's recommendations and instructions.
- B. Mounting height for surface mounted equipment: See Specification Section 26 05 00.
- C. Combination and Manual Starter Enclosures:
  1. Permitted uses of NEMA 4 enclosure:
    - a. Surface mounted in areas designated as damp or wet.

## **END OF SECTION**

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## **SECTION 26 27 26**

### **WIRING DEVICES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Wall switches.
    - b. Receptacles.
    - c. Device wallplates and coverplates.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 26 05 00 - Electrical: Basic Requirements.
  - 4. Section 26 05 33 - Raceways and Boxes.
  - 5. Section 26 24 19 - Motor Control Equipment.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. WD 1, General Color Requirements for Wiring Devices.
    - c. WD 6, Wiring Devices - Dimensional Requirements.
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. 20, General-Use Snap Switches.
    - b. 498, Standard for Attachment Plugs and Receptacles.
    - c. 514A, Metallic Outlet Boxes.
    - d. 894, Standard for Switches for Use in Hazardous (Classified) Locations.
    - e. 943, Ground-Fault Circuit-Interruption.
    - f. 1010, Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
    - g. 1310, Standard for Class 2 Power Units.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.

#### **PART 2 - PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Wall switches and receptacles:
    - a. Bryant Electric.
    - b. Cooper Wiring Devices by Eaton.

- c. Hubbell Incorporated Wiring Device-Kellems.
- d. Leviton Manufacturing Company.
- e. Legrand/Pass & Seymour.
- f. Eaton Crouse-Hinds.
- g. Appleton Electric Co.
- h. Hubbell Killark.

## 2.2 WALL SWITCHES

- A. Basic requirements unless modified in specific requirements paragraph of switches per designated areas or types:
  - 1. Industrial Specification Grade.
  - 2. Quiet action, snap switch.
  - 3. Self grounding with grounding terminal.
  - 4. Back and side wired.
  - 5. Solid silver cadmium oxide contacts.
  - 6. Rugged thermoplastic and/or nylon housing and one-piece switch arm.
  - 7. Ratings: 20 A, 120/277 VAC.
  - 8. Switch handle type: Toggle.
  - 9. Switch handle color: Brown.
  - 10. Types as indicated on the Drawings:
    - a. Single-pole.
    - b. Double-pole.
    - c. 3-way.
    - d. 4-way.
    - e. Momentary contact.
  - 11. Standards: UL 20, UL 514A, NEMA WD 1, NEMA WD 6.
- B. Wet or Damp Non-Architecturally Finished or Exterior Area Specific Requirements:
  - 1. Coverplate:
    - a. Cast iron alloy, gasketed, stainless steel hardware, galvanized and factory painted finish.
    - b. Operator type:
      - 1) Side mounted rocker type handle to operate snap switch.
      - 2) Front mounted lever type handle to operate snap switch.
      - 3) Push/pull operator to operate snap switch.
      - 4) Spring type door to cover snap switch.
    - c. Wet location rated.
    - d. Single or multiple gang as required.

## 2.3 RECEPTACLES

- A. Basic requirements unless modified in specific requirements paragraph of receptacles and per designated areas:
  - 1. Industrial Specification Grade.
  - 2. Straight blade.
  - 3. Brass triple wipe line contacts.
  - 4. One-piece grounding system with double wipe brass grounding contacts and self-grounding strap with grounding terminal.
  - 5. Back and side wired.
  - 6. Rating: 20 A, 125 VAC.
  - 7. High impact nylon body.
  - 8. Receptacle body color:
    - a. Normal power: Brown.
  - 9. Duplex or simplex as indicated on the Drawings.
  - 10. Configuration: NEMA 5-20R.
  - 11. Standards: UL 498, UL 514A, NEMA WD 1, NEMA WD 6.



- B. Receptacle Type Specific Requirements:
  - 1. Basic receptacles:
    - a. Weather-resistant when located in exterior locations or interior damp or wet areas as indicated on the Drawings.
      - 1) Identification: Letters "WR" on face of receptacle.
  - 2. Ground Fault Circuit Interrupter (GFCI):
    - a. Specification Grade.
    - b. Class A protection.
    - c. Feed through type.
    - d. Test and reset buttons.
    - e. Self-testing.
    - f. Visual indicator light.
    - g. Weather-resistant when located in exterior locations or interior damp or wet areas as indicated on the Drawings.
      - 1) Identification: Letters "WR" on face of receptacle.
    - h. Tamper resistant.
    - i. Additional standards: UL 943.
- C. Damp Non-Architecturally Finished Areas Specific Requirements:
  - 1. Coverplate:
    - a. Cast iron alloy, gasketed, self-closing cover, stainless steel hardware, galvanized and factory painted finish.
    - b. Weatherproof when receptacle is covered.
    - c. Single or multiple gang as required.
- D. Wet Non-architecturally Finished Areas Specific Requirements:
  - 1. Coverplate:
    - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 IN minimum cover depth for #12 AWG cords.
- E. Exterior Locations Specific Requirements:
  - 1. Coverplate:
    - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 IN minimum cover depth for #12 AWG cord.

## **2.4 MISCELLANEOUS WIRING DEVICES**

- A. Manual Motor Starters: Horsepower rated with or without thermal overloads, see Specification Section 26 24 19.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Mount devices where indicated on the Drawings and as scheduled in Specification Section 26 05 00.
- C. See Specification Section 26 05 33 for device outlet box requirements.
- D. Where more than one (1) receptacle is installed in a room, they shall be symmetrically arranged.
- E. Provide blank plates for empty outlets.

## **END OF SECTION**

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**SECTION 26 28 00**  
**OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Low voltage circuit breakers.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 26 05 00 - Electrical: Basic Requirements.
  - 4. Section 26 08 13 - Acceptance Testing.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
    - b. C37.16, Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations.
    - c. C37.17, Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.
  - 2. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 3. Underwriters Laboratories, Inc. (UL):
    - a. 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
    - b. 943, Standard for Safety for Ground-Fault Circuit-Interruption.
    - c. 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Reports:
    - a. As-left condition of all circuit breakers that have adjustable settings.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Circuit breakers:
    - a. Eaton.
    - b. General Electric Company.
    - c. Square D Company.
    - d. Siemens.
- B. Submit request for substitution in accordance with Specification Section 00 72 13.

### **2.2 CIRCUIT BREAKERS**

- A. Molded Case Type:
  - 1. General:
    - a. Standards: UL 489.
    - b. Unit construction.
    - c. Over-center, toggle handle operated.
    - d. Quick-make, quick-break, independent of toggle handle operation.
    - e. Manual and automatic operation.
    - f. All poles open and close simultaneously.
    - g. Three (3) position handle: On, off and tripped.
    - h. Molded-in ON and OFF markings on breaker cover.
    - i. One-, two- or three-pole as indicated on the Drawings.
    - j. Current and interrupting ratings as indicated on the Drawings.
    - k. Bolt on type.
  - 2. Thermal magnetic type:
    - a. Inverse time overload and instantaneous short circuit protection by means of a thermal magnetic element.
    - b. Frame size 150 amp and below:
      - 1) Non-interchangeable, non-adjustable thermal magnetic trip units.
    - c. Frame sizes 225 to 400 amp (trip settings less than 400A):
      - 1) Interchangeable and adjustable instantaneous thermal magnetic trip units.
  - 3. Motor circuit protector:
    - a. Adjustable instantaneous short circuit protection by means of a magnetic or solid state trip element.
    - b. Sized for the connected motor.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Current and interrupting ratings as indicated on the Drawings.
- B. Series rated systems not acceptable.
- C. Devices shall be ambient temperature compensated.
- D. Circuit Breakers:
  - 1. Molded case circuit breakers shall incorporate the following, unless indicated otherwise on the Drawings:
    - a. Frame sizes 400 amp and less with trip setting less than 400A shall be thermal magnetic type.
    - b. Motor circuit protectors sized for the connected motor.

### **3.2 FIELD QUALITY CONTROL**

- A. Adjustable Circuit Breakers:
  - 1. Set all circuit breaker adjustable taps as defined on the Drawings, except adjust motor circuit protectors per the motor nameplate and NFPA 70 requirements.
- B. Testing:
  - 1. Acceptance testing: See Specification Section 26 08 13.

**END OF SECTION**

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## **SECTION 26 28 16**

### **SAFETY SWITCHES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Safety switches.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 26 05 00 - Electrical: Basic Requirements.
  - 4. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. 98, Enclosed and Dead-Front Switches.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. Provide a Summary Table or use Exhibit A that associates the safety switch features with connected equipment tag number. Exhibit A indicates minimum data required.
    - c. See Specification Section 26 05 00 for additional requirements.

#### **PART 2 - PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following safety switch manufacturers are acceptable:
  - 1. Eaton
  - 2. General Electric Company.
  - 3. Square D Company.
  - 4. Siemens.
  - 5. Appleton Electric Company.
  - 6. Crouse-Hinds.
  - 7. Killark.

##### **2.2 SAFETY SWITCHES**

- A. General:
  - 1. Non-fusible or fusible as indicated on the Drawings.
  - 2. Suitable for service entrance when required.

3. NEMA Type HD heavy-duty construction.
  4. Switch blades will be fully visible in the OFF position with the enclosure door open.
  5. Quick-make/quick-break operating mechanism.
  6. Deionizing arc chutes.
  7. Manufacture double-break rotary action shaft and switchblade as one (1) common component.
  8. Clear line shields to prevent accidental contact with line terminals.
  9. Operating handle:
    - a. Red and easily recognizable.
    - b. Padlockable in the OFF position
    - c. Interlocked to prevent door from opening when the switch is in the ON position with a defeater mechanism.
- B. Ratings:
1. Horsepower rated of connected motor.
  2. Voltage and amperage: As indicated on the Drawings.
  3. Short circuit withstand:
    - a. Non-fused: 10,000A.
    - b. Fused: 200,000A.
- C. Accessories, when indicated in PART 3 of this Specification Section or on the Drawings:
1. Neutral kits.
  2. Ground lug kits.
  3. Auxiliary contact kits:
    - a. Opens before main switch.
    - b. Rated 10A at 125/250 VAC.
    - c. One (1) N.O. and one (1) N.C. contact.
- D. Enclosures:
1. NEMA 4 rated:
    - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    - b. No knockouts, external mounting flanges, hinged, gasketed and lockable door.
- E. Overcurrent and short circuit protective devices:
1. Fuses.
  2. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
- F. Standards: NEMA KS 1, UL 98.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install as indicated and in accordance with manufacturer's instructions and recommendations.
- B. Install switches adjacent to the equipment they are intended to serve unless otherwise indicated on the Drawings.
- C. Provide auxiliary contact kit on local safety switches for motors being controlled by a variable frequency drive.
  1. The VFD is to be disabled when the switch is in the open position.
- D. Permitted uses of NEMA 4 enclosure:
  1. Surface mounted in areas designated as damp and/or wet.



**SECTION 26 29 23**  
**VARIABLE FREQUENCY DRIVES - LOW VOLTAGE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Variable frequency drives (VFDs) for operation of inverter duty motors.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 10 14 00 - Identification Devices.
  - 2. Section 26 05 00 - Electrical - Basic Requirements.
  - 3. Section 26 24 19 - Motor Control Equipment.
  - 4. Section 01 61 03 - Equipment - Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American National Standards Institute (ANSI).
  - 2. ETL Testing Laboratories (ETL).
  - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
    - b. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
    - c. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
  - 4. National Electrical Manufacturer's Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. MG 1, Motors and Generators.
  - 5. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC):
      - 1) Article 430, Motors Motor Circuits, and Controllers..
  - 6. Occupational Safety and Health Administration (OSHA).
  - 7. Underwriters Laboratory, Inc. (UL):
    - a. 508, Standard for Industrial Control Equipment.
    - b. 508A, Standard for Industrial Control Panels.
- B. Qualifications:
  - 1. Provide drives that are listed and labeled by UL, ETL, or other Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.
    - a. Drives shall be UL listed for the application of phase conversion as specified on the drawings.
  - 2. Where listed drives and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508 and UL 508A or equivalent NRTL standard.
    - a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" or equivalent NRTL label prior to shipment to the jobsite.
    - b. Drive accessories including capacitor kits, reactors, etc. shall be UL listed for the application of phase conversion as specified on the drawings.
  - 3. VFD Supplier shall maintain an authorized service organization within 300 miles of the Project Site.
- C. Coordination:

1. The intent of this Specification Section is to allow the VFD manufacturer to provide the best solution for the harmonic and motor protection outlined herein.
  - a. This solution shall include, but not be limited to, all aspects of the distribution system including standby generation, motor feeder cable type and available floor space.
2. Motor and VFD coordination: See Specification Section 01 61 03.
3. VFD shall be supplied complete with all required control components.
  - a. Provide control as indicated:
    - 1) On the electrical drawings.
    - 2) As specified in this Specification Section.
  - b. VFD manufacturer shall review the application and provide, at no additional cost to the Owner, the hardware and software necessary to allow the VFD to control the driven equipment motor over its required operating range.
    - 1) These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.
  - c. Coordinate control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leak detectors, etc.
4. Verify plan dimensions with equipment space requirements as indicated on the Drawings.
  - a. Equipment which exceeds the allotted maximum dimensions may not be acceptable.
  - b. Equipment which reduces clear work space below the minimums established by the NFPA 70 will not be acceptable.

### 1.3 DEFINITIONS

- A. Variable Torque (VT):
  1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as speed is reduced below full rated.
  2. This type of load permits the VFD and the motor to operate at reduced output current at reduced speed.
- B. Constant Torque (CT):
  1. Defines a load characteristic in which the torque delivered from the motor to the load remains constant as speed is varied.
  2. This type of load requires the VFD to be able to continuously deliver rated output current over the entire speed range.
- C. Constant Horsepower:
  1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as the speed is increased.
  2. This characteristic is required for operation of the VFD and motor above rated frequency to maintain output current within the rated value.
- D. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.
- E. Standard Motor: An AC induction motor that fails to comply with one or more requirements of NEMA MG 1 Part 31.
- F. Low Voltage: 600 VAC or less.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  1. Provide a schedule for each VFD including the following information:
    - a. Equipment Tag Number.
    - b. VFD Complete Catalog Number.
    - c. VFD Amp Frame Size.
    - d. Variable or Constant Torque Rating Basis.
    - e. Rated Input Current.
    - f. Rated Continuous Output Current.

- g. Rated Short Circuit Current.
- h. VFD cable type specified (shielded or non-shielded).
- i. VFD Maximum Motor Lead Length for the type of cable used.
- j. Motor Manufacturer.
- k. Motor Frame Size.
- l. Motor Full Load Amps.
- m. Motor Service Factor.
- n. As installed motor Lead Length.
- o. VFD options provided to meet harmonic or motor protection specifications.
- 2. Submit VFD Shop Drawings concurrently with driven equipment and motor Shop Drawings.
- 3. Product technical data:
  - a. Complete electrical ratings and performance specifications confirming compliance with specified ratings and performance.
  - b. Maximum rate of heat rejection from VFD and all related components and associated cooling requirements.
  - c. Manufacturer's installation instructions.
  - d. Manufacturer's programming and operating instructions.
  - e. See Specification Section 26 05 00 for additional requirements.
- 4. Fabrication and/or layout drawings:
  - a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.
  - b. Identify minimum clearances from other VFDs or electrical equipment required for proper cooling at top, bottom, side and back of enclosure.
  - c. Three-line diagrams showing AC schematic of VFD, input, output and bypass devices including device ratings.
  - d. Interior layout drawings showing location of all components within enclosure, field wiring terminal boards, and power and grounding connections.
  - e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.
  - f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
- 5. Certifications:
  - a. Submit with Shop Drawings:
    - 1) Identification and location of closest authorized service organization.
    - 2) Harmonic analysis at each PCC per Harmonic Protection Requirements Article.
  - b. Submit prior to shipment:
    - 1) Certified factory test reports confirming compliance with specified requirements.
  - c. Submit after installation:
    - 1) Certified field service reports showing:
      - a) Each VFD is operational.
      - b) Each VFD and its driven equipment motor are compatible.
      - c) Each VFD responds correctly to the input control signals.
      - d) Critical frequencies of the drive system and that the VFD has been set to lockout these frequencies.
      - e) Measured harmonic levels per Harmonic Protection Requirements Article.
      - f) Measured motor terminal peak voltages per Motor Protection Requirements Article.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
  - 2. Approved copy of VFD schedule per Submittals Article.

3. Manufacturer's instruction manuals.
4. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.
5. Connection data to permit removal and installation of recommended smallest field-replaceable parts.
6. Recommended spare parts list.
7. Commissioning sheets showing "as-left" values of all user-programmable or adjustable drive parameters.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Allen Bradley.
  2. ABB.
  3. Eaton.
  4. Danfoss.
  5. Siemens/Robicon.
  6. Siemens.
  7. Square D Company.
  8. Toshiba.
  9. Yaskawa.

### **2.2 GENERAL**

- A. VFDs shall consist of a rectifier-DC bus-inverter combination producing a sine-coded pulse-width-modulated (PWM) output voltage waveform.
- B. VFDs shall constitute a complete combination motor controller per NFPA 70, Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.
  1. Motor control.
  2. Motor overload protection.
  3. Motor and motor branch circuit short circuit and ground fault protection.
  4. Motor and controller disconnecting means.
- C. VFDs shall be capable of converting 1-phase input to 3-phase output without impacting operational capacity and service life.
- D. It is the intent of this Specification that VFDs shall be an "engineered" or "configured" drive package in which the VFD chassis, all input, output and bypass power devices, VFD accessories, ancillary switches, contactors, relays, and related control devices are selected, furnished, factory-assembled and -tested by the VFD manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

### **2.3 PERFORMANCE AND DESIGN REQUIREMENTS**

- A. Application:
  1. VFD(s) shall be of sufficient capacity and shall provide a quality of output waveform for stepless motor control from 10 to 100% of base speed of the driven equipment.
  2. VFDs shall be compatible with:
    - a. Inverter duty induction motors.
  3. VFDs shall be suitable for Constant Torque (CT) or Variable Torque (VT) applications.
    - a. VFD manufacturer shall coordinate with the manufacturer of the driven equipment to identify CT and VT applications.
  4. VFDs shall be designed to operate successfully under the following site conditions:
    - a. Ambient:

- 1) Temperature: 0-40 degrees C.
    - 2) 95% non-condensing relative humidity.
  - b. Elevation: Less than 3,300 feet above MSL.
  - c. Power supply characteristics:
    - 1) 240Vac, 1 PH, 60 Hz, 2 wire, ( $\pm 10\%$ ).
    - 2) Effectively grounded.
- B. Ratings and Performance Specifications:
  - 1. Voltage rating:
    - a. Nominal: 240 VAC, 3 PH, 60 Hz.
    - b. Range for continuous full load operation:  $\pm 10\%$  of nominal.
    - c. Voltage imbalance tolerance for full load operation: 3% minimum.
  - 2. Current ratings:
    - a. Continuous:
      - 1) Equal to or greater than the motor nameplate full load.
    - b. Short-term overload:
      - 1) VT: 110% for 1 minute.
      - 2) CT: 150% for 1 minute.
      - 3) Permissible for 1 minute every 10 minutes continuously.
    - c. Short circuit:
      - 1) Where a short circuit rating is not indicated or specified for individual VFDs, each VFD shall have a rating not less than indicated on the Drawings for the MCC, switchboard or panelboard the VFD is supplied from.
      - 2) Where specified short circuit rating indicates additional input impedance is required to protect semiconductors, provide input AC line reactors, whether required to meet harmonic performance specifications or not.
  - 3. Efficiency:
    - a. 97%, minimum, at full speed and full load.
    - b. 93%, minimum at 1/2 speed and full load.
  - 4. Displacement power factor:
    - a. 95%, minimum from 50% to 100% speed and load.
  - 5. Efficiency and power factor criteria apply from the input terminals to the output terminals of the VFD alone, excluding losses of input and output power circuit accessories.
  - 6. Frequency drift:
    - a.  $+0.5\%$  of set frequency.
  - 7. Speed regulation (motor dependent): 3%.
  - 8. Speed range: 10:1.
  - 9. Control type:
    - a. Volts/Hertz ratio; constant over the entire operating range of the VFD except:
      - 1) When operating under voltage boost.
      - 2) At frequencies over 60 Hz.
- C. Operational Features:
  - 1. Insensitive to input phase sequence.
  - 2. Continued operation with momentary voltage dips of 25% of rated voltage, or single phase condition: 4 seconds, minimum.
  - 3. Controls power loss ride-through: 500 MSEC, minimum.
  - 4. Electronic reversing.
  - 5. DC injection braking.
  - 6. Anti-windmilling: Synchronization of VFD starting frequency with spinning or coasting load, forward or reverse.
  - 7. Critical frequency band lockout:
    - a. Minimum of three settings.
    - b. Adjustable bandwidth, 1 - 5 Hz.
  - 8. Capable of operating without the motor connected for start-up and troubleshooting.

- D. The VFD shall be provided with the following minimum user-programmable parameters:
1. Carrier frequency.
  2. Independent maximum and minimum speeds for forward and reverse operation.
  3. Start frequency and hold time.
  4. Independent linear acceleration and deceleration time.
  5. Preset "jog" speed.
  6. Three critical frequency bands.
  7. One preset speed selectable by logic input.
  8. Volts/Hertz ratio.
  9. Voltage boost, magnitude and frequency range.
  10. Process controller gain, offset and bias.
  11. Current limit.
  12. Overcurrent pickup.
  13. Overcurrent delay.
  14. Ground fault pickup.
  15. DC injection level and time.
- E. The VFD shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:
1. General:
    - a. Shutdown conditions associated with supply circuit conditions which can be corrected external to the VFD-motor system shall be provided with automatic reset, with shutdown cause logged in memory:
      - 1) Input under voltage.
      - 2) Input over voltage.
      - 3) Input under frequency.
      - 4) Input over frequency.
      - 5) Input Phase loss.
      - 6) DC Bus under voltage.
    - b. Shutdown conditions which indicate overload or fault within the VFD, the output circuit, or the motor shall require local manual reset at the VFD, requiring operator intervention.
      - 1) Over temperature.
      - 2) Blown fuse.
      - 3) Component failure.
      - 4) Overload.
      - 5) Short circuit.
      - 6) Ground fault.
      - 7) DC Bus over voltage.
      - 8) External safety input (e.g., motor thermal protection).
      - 9) Logic fault.
    - c. Protection settings shall be adjusted so as not to cause un-desired tripping due to phase conversion operation.
    - d. When automatic shutdown occurs, VFD shall restart immediately upon reset, whether automatic or manual.
    - e. VFD shall hold cause of trip data for a minimum of four shutdowns in memory.
      - 1) Data to be accessible through the keypad, local communication link and remotely.
  2. Input protection:
    - a. Input circuit breaker or current-limiting fuses with externally operable disconnect.
      - 1) Fault current interrupting rating equal to or greater than the specified withstand rating of the VFD.
      - 2) Handle padlockable in the OFF position.
    - b. Provide full protection for semiconductors integral to the VFD; units requiring current-limiting fuses or circuit breakers in the supply circuit are not acceptable.
    - c. Incoming line transient suppression.

- 1) 6000V peak per IEEE C62.41.
- 2) Phase-to-phase and phase-to-ground protection.
- d. Sustained over voltage trip.
- 3. Internal protection:
  - a. Surge suppression and power device snubbers.
  - b. Power devices rated at 2.5 times line voltage.
  - c. Instantaneous over current trip.
  - d. DC bus over voltage trip.
  - e. Power device over temperature trip.
  - f. Control logic circuit malfunction trip.
- 4. Output protection:
  - a. Inverse-time overload trip:
    - 1) UL Class 10 characteristic.
  - b. Over voltage trip.
  - c. Over frequency trip.
  - d. Short circuit trip.
    - 1) Line to line and line to ground.
  - e. Ground fault trip.

## 2.4 OPERATOR AND REMOTE CONTROL INTERFACE

- A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.
  - 1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.
- B. Control circuits shall be 120 VAC.
  - 1. 120 VAC supplied by CPT in the VFD.
    - a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.
    - b. CPT shall have two fuses on the primary side and one fuse on the secondary side.
    - c. CPT shall have surge protection on the primary side independent of any other surge protection in the VFD.
- C. Operator Interface:
  - 1. Door mounted sealed keypad, membrane type with LED or LCD display.
    - a. Messages shall be in English and engineering units.
    - b. Drive operating parameters shall be programmable.
    - c. Menu driven.
    - d. Password security.
    - e. Display fault and diagnostic data.
    - f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.
    - g. Gold plated plug-in contacts.
  - 2. Provide indication and control interface, integral in the keypad, as required in the sequence of operation and Drawings.
    - a. Minimum indications:
      - 1) Run.
      - 2) Stop.
      - 3) Ready.
      - 4) Alarm.
      - 5) Fault.
      - 6) Local control.
      - 7) Remote control.
      - 8) Control source local.
      - 9) Control source remote.
      - 10) Speed indication.

- b. Minimum control functions:
      - 1) Hand/Auto switch.
      - 2) Stop button.
      - 3) Start button.
      - 4) Reset button.
      - 5) Speed control buttons.
  - 3. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.
    - a. On occurrence of more than one condition, each shall be recorded or indicated by the diagnostics.
- D. Remote Control Interface:
  - 1. Analog and discrete inputs:
    - a. Speed reference (setpoint) signal 4-20 mA DC.
  - 2. Analog and discrete outputs:
    - a. 4-20 mA DC output for remote speed indication, as a function of frequency, calibrated 0 to 100%.
    - b. Drive FAULT contacts.
    - c. Drive RUNNING contacts.
    - d. Drive selector switch in AUTO status contacts.
  - 3. Contacts:
    - a. Contacts shall be rated 2 A inductive at 120 VAC.
    - b. All contacts shall be wired to field wiring terminal boards.
  - 4. Network communications capability:
    - a. Provide VFD with communication card, protocol and required programming for digital communication of all VFD program and operational parameters to plant control system via:
      - 1) Ethernet IP.

## 2.5 HARMONIC PROTECTION REQUIREMENTS

- A. All VFDs shall be capable of satisfactory operation from a source having voltage distortion and notch characteristics identified as acceptable for a “dedicated system” in IEEE 519 Table 10.2.
- B. With all VFDs operating under worst-case harmonic current conditions, and the facility supplied from the utility, the VFDs shall not produce harmonic effects in excess of the following limits at any point of common coupling (PCC).
  - 1. Voltage distortion and notch characteristics: IEEE 519 Table 10.2 for General System.
  - 2. Current distortion: IEEE 519 Table 10.3 based on calculated  $I_{SC}/I_L$  at each PCC.
- C. PCC shall be considered:
  - 1. Building service entrance switchgear, switchboard or MCC.
- D. The Engineer has performed preliminary calculations based on typical VFD data which indicate that the minimum mitigation measures required to meet the specified harmonic criteria are one of the following topologies:
  - 1. 6-pulse rectifier topology.
  - 2. 6-pulse rectifier topology with input line reactors or DC link reactors, minimum impedance 5% on drive kVA base.
- E. VFD manufacturer shall determine, for their proposed equipment, uncorrected harmonic distortion levels and mitigation techniques required to meet the specified limits and shall furnish the VFD types and all accessory items and equipment necessary to do so, whether specified herein or not.
- F. VFD manufacturer shall provide a harmonic analysis of the distribution system based on their proposed specific equipment characteristics and mitigation techniques confirming that the specified levels are not exceeded.
  - 1. Analysis shall be based on the methodology of IEEE 519 and IEEE 399.



2. Power system data for analysis shall be taken from the electrical drawings and approved equipment submittals.
  - a. VFDs provided in a package with equipment specified elsewhere, shall be included in the analysis.
- G. Following start-up, with facility at full load operation, provide measurement of harmonic voltage, current and notch characteristics at each PCC according to the requirements of IEEE 519 Section 9.
  1. Values in excess of specified limits require correction by contractor and re-measurement.
  2. Provide certification of compliant measurements as part of Field Service Engineer's final report.

## **2.6 MOTOR PROTECTION REQUIREMENTS**

- A. The VFD shall produce a quality of output waveform adequate to allow the motor to produce rated torque at rated RPM continuously without exceeding the temperature rise given in NEMA MG 1 Table 31-2.
- B. Provide motor overload, short circuit and ground fault protection integral to drive electronics.
- C. The VFD shall not produce voltage spikes in excess of the following values at the motor terminals when operated with the feeder types shown on the Drawings and the actual installed feeder lengths.
  1. If unmitigated voltage peaks exceed the specified limits, provide output line reactors, filters, or other devices as required to meet the specified limits:
    - a. Inverter duty motors: 1280 V.
    - b. Rise time shall be greater than or equal to 0.1 microsecond.
    - c. Motor lead length and data shall be determined by the Contractor based on the actual routing of the conductors.

## **2.7 EQUIPMENT CONSTRUCTION**

- A. Fabrication and Assembly:
  1. Each VFD system shall be factory-assembled in an enclosure for remote mounting, and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible.
    - a. Factory assembly shall be performed by the VFD manufacturer or authorized agent.
    - b. Systems fabricated or assembled in whole or in part by parties other than the VFD manufacturer or authorized agent will not be acceptable.
  2. Reactors and/or filters, where required, shall be mounted within or in an ancillary enclosure adjacent to the drive enclosure, or with the Engineer's permission may be mounted in a separate enclosure.
  3. Cooling fans, as required, shall be provided to run when drive is running.
  4. Enclosures for separately mounted VFD's:
    - a. NEMA Type 4 for installations in wet, damp or outdoor areas.
      - 1) Provide enclosure cooling required to not exceed drive temperature ratings.
- B. Wiring:
  1. The wiring in the VFD shall be neatly installed in wire ways or with wire ties where wire ways are not practical.
    - a. Where wire ties are used, the wire bundles are to be held at the back panel with a screw-mounted wire tie mounting base.
    - b. Bases with a self-sticking back will not be allowed.
  2. All plug-in contacts shall be gold-plated.
  3. Provide terminal boards for all field wiring and inter-unit connections, including analog signals.
    - a. Provide terminals for shield continuity where required.

4. Terminal blocks shall be complete with marking strip, covers and pressure connectors.
    - a. Non-brittle, interlocking, track-mounted type.
    - b. Screw terminals will not be allowed.
    - c. A terminal for each conductor of external circuits plus one ground for each shielded cable.
    - d. For free-standing panels, 8 inches of clearance shall be provided between terminals and the panel base for conduit and wiring space.
    - e. Not less than 25% spare terminals shall be provided.
    - f. Terminals shall be labeled to agree with identification indicated on the suppliers submittal drawings.
    - g. Individually fuse each control loop or system and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
  5. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue terminal.
    - a. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.
  6. Wiring shall not be kinked or spliced and shall have markings on both ends or be color coded.
    - a. Markings or color code shall match the manufacturer's drawings.
  7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, type MTW or SIS, insulated for not less than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90 DegC.
- C. Nameplates:
1. All devices mounted on the face of the drive shall be provided with a suitable nameplate as specified in Specification Section 10 14 00.
  2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate.
  3. Relays, terminals and special devices inside the control enclosure shall have permanent markings to match identification used on manufacturer's wiring diagrams.
- D. Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and given at least one (1) coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

## **2.8 COMPONENTS AND ACCESSORIES**

- A. Reactors:
1. Impedance: 5%, or as required.
  2. Continuous current: Not less than drive rating.
  3. Current overload: 150% for 1 minute.
  4. Insulation temperature rating: 180 degrees C.
  5. Copper windings.
  6. Saturation current rating: 3.5 to 5 times rated current.
  7. Hi-potential rating: 2500 VAC line to ground and line to line, for 1 minute.
  8. Noise reduction features:
    - a. Epoxy over cast coil.
    - b. Extra dips and bakes of varnish over continuous wound coil.

## **2.9 SOURCE QUALITY CONTROL**

- A. Factory Tests:
1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specification requirements.

## **2.10 MAINTENANCE MATERIALS**

- A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).

- B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.
- B. Provide separately mounted VFD enclosure with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
  - 1. Determine the SCCR rating by one of the following methods:
    - a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
    - b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
    - c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
  - 2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
  - 3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.
- C. Verify the installed motor nameplate electrical requirements do not exceed the VFD capacity.
- D. Provide services of manufacturer's representative to perform start-up services.
- E. The selection of input and output harmonic and voltage spike protection shall also be made on the available physical space.
  - 1. The space available on the Drawings shall not be exceeded.

### **3.2 START UP**

- A. Pre-start-up Services:
  - 1. Shall be completed a minimum of 30 days prior to the start-up and demonstration period described in Specification Section 01 75 00.
  - 2. Shall consist of:
    - a. Physical and electrical installation check.
    - b. Final adjustments and calibration of drive parameters.
    - c. VFD operation from simulated input signals.
  - 3. Shall be complete when VFD(s) are fully operational.
- B. Field Quality Control:
  - 1. Perform field measurement of harmonics at each PCC per Harmonic Protection Requirements Article.
    - a. For each individual VFD.
    - b. For the maximum number of VFDs that will be operational at the same time.
    - c. When all loads are at 75% load minimum.
    - d. Duration: 1 hour minimum.
  - 2. Perform field measurement of the maximum voltage peak at the terminals of each motor fed from a VFD per Motor Protection Requirements Article.
    - a. Use a high speed oscilloscope to produce a plot of Voltage (Y axis) versus Time (X axis).
      - 1) Time shall be measured in microseconds.
    - b. Tests shall be performed at full:
      - 1) Full voltage and speed.
      - 2) Loaded to 75% minimum.
      - 3) Duration: 1 hour minimum.
  - 3. Record all data necessary for the preparation of required test reports.

- C. Start-up and Demonstration Services:
  - 1. Supervise start-up of all units including recheck of settings made during the pre-start-up tests.
    - a. Perform all work in the presence of the Owner's designated representatives.
  - 2. Setup all VFDs with carrier frequency at minimum value consistent with proper operation; inform Engineer of carrier frequencies set in excess of 5 kHz and reason for setting.
  - 3. Simulate operation of the VFD and its associated control and instrumentation system in both the manual and automatic modes.
    - a. Ensure compatibility of VFD with associated control and instrumentation signals.
  - 4. Simulate VFD failures and demonstrate troubleshooting aids.
- D. Instruct Owner's designated personnel:
  - 1. Minimum of 8 hours at the jobsite.
  - 2. Include both field and classroom instruction.
  - 3. Instructions shall include proper operation and maintenance procedures including, but not limited to:
    - a. Lubrication.
    - b. Troubleshooting.
    - c. Repair and replacement.
    - d. Parts inventory.
    - e. Maintenance records.

## **SECTION 26 36 00**

### **TRANSFER SWITCHES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Integrated Manual transfer switches with Portable Generator Connection.
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. 98, Standard for Safety Enclosed and Dead-Front Switches.
    - b. 1008, Standard for Safety Switch Equipment.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification:
    - b. See Section 26 05 00 for additional requirements.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

##### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. See Section 26 05 00.

#### **PART 2 - PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the listed manufacturers are acceptable:
  - 1. Manual transfer switches:
    - a. Trystar
    - b. Automatic Switch Company.
    - c. Eaton.
    - d. Russelectric.
    - e. Square D Company.
    - f. Siemens.
    - g. ABB Zenith.

##### **2.2 MANUAL TRANSFER SWITCH**

- A. Double throw load break rated with:
  - 1. Quick-make/quick-break operating mechanism.
  - 2. Deionizing arc chutes.

3. Double-break rotary action shaft and switchblade shall be manufactured as one common component.
  4. Clear line shields to prevent accidental contact with line terminals.
  5. MTS shall have three positions – Utility/Permanent Line – OFF – Temporary Line
- B. Operating handle: Easily recognizable and padlockable in all positions.
- C. Wiring configuration to allow single load to be supplied by a normal or alternate source.
- D. Ratings:
1. Voltage and amperage: As indicated on Drawings.
  2. Short circuit withstand: Equal to or greater than the upstream equipment.
  3. Service-entrance rated with circuit breaker.
- E. Enclosure:
1. NEMA 3R rated:
    - a. Aluminum body
    - b. No knockouts, external mounting flanges, hinged, lockable door.
  2. NEMA 4X rated:
    - a. Body and cover: Type 304 or 316 stainless steel.
    - b. No knockouts, external mounting flanges, hinged, gasketed and lockable door.
- F. Connectors:
1. Camlock style connectors
  2. Color-coded according to system voltage
  3. Protected against accidental contact while not in use.
- G. Standards: NEMA KS 1, UL 98.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Connect as indicated in one-line diagram.
- C. Mounting of manual transfer switches: Floor mounted on 4 inches high concrete pad.

### **3.2 FIELD QUALITY CONTROL**

- A. Transfer Switch Testing:
1. Perform a manual transfer and retransfer.
  2. Verify proper power flow in all switch configurations.
  3. Perform each visual and mechanical inspection and electrical test stated in NETA acceptance Testing Specification. Certify compliance with test parameters.

## **END OF SECTION**

**SECTION 26 43 13**  
**LOW VOLTAGE SURGE PROTECTION DEVICES (SPD)**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. High exposure locations (panelboard), externally mounted.
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
    - b. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits.
    - c. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
    - d. C62.45, Recommended Practice on Surge Testing For Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits.
  - 2. Military Standard:
    - a. MIL-STD-220B, Method of Insertion-Loss Measurement.
  - 3. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. LS 1, Low Voltage Surge Protective Devices.
  - 4. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 5. Underwriters Laboratories, Inc. (UL):
    - a. 1283, Standard for Electromagnetic Interference Filters.
    - b. 1449, Standard for Safety Transient Voltage Surge Suppressors.
- B. Qualifications:
  - 1. Provide devices from a manufacturer who has been regularly engaged in the development, design, testing, listing and manufacturing of SPDs of the types and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.
    - a. Upon request, suppliers or manufacturers shall provide a list of not less than three (3) customer references showing satisfactory operation.

**1.3 DEFINITIONS**

- A. Clamping Voltage:
  - 1. The applied surge shall be induced at the 90 degree phase angle of the applied system frequency voltage.
  - 2. The voltage measured at the end of the 6 IN output leads of the SPD and from the zero voltage reference to the peak of the surge.
- B. Let-Through Voltage:
  - 1. The applied surge shall be induced at the 90 degree phase angle of the applied system frequency voltage.

2. The voltage measured at the end of the 6 IN output leads of the SPD and from the system peak voltage to the peak of the surge.
- C. Maximum Continuous Operating Voltage (MCOV): The maximum steady state voltage at which the SPD device can operate and meet its specification within its rated temperature.
- D. Maximum Surge Current:
  1. The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10 PCT deviation of clamping voltage at a specified surge current.
  2. Listed by mode, since number and type of components in any SPD may vary by mode.
- E. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements, i.e., line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), neutral-to-ground (N-G).
- F. Surge Current per Phase:
  1. The per phase rating is the total surge current capacity connected to a given phase conductor.
    - a. For example, a wye system surge current per phase would equal L-N plus L-G; a delta system surge current per phase would equal L-L plus L-G.
    - b. The N-G mode is not included in the per phase calculation.
- G. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 480/277 V system the L-L peak voltage is 679V and the L-N peak voltage is 392 V).

#### 1.4 SUBMITTALS

- A. Shop Drawings:
  1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Product technical data including:
    - a. Manufacturer's qualifications.
    - b. Standard catalog cut sheet.
    - c. Electrical and mechanical drawing showing unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
    - d. Testing procedures and testing equipment data.
    - e. Create a Product Data Sheet for each different model number of SPD provided (i.e., Model XYZ with disconnect and Model XYZ without disconnect, each require a Product Data Sheet).
      - 1) Data in the Product Data Sheet heading:
        - a) SPD Type Number per PART 2 of the Specification.
        - b) Manufacturer's Name.
        - c) Product model number.
      - 2) Data in the Product Data Sheet body:
        - a) Column one: Specified value/feature of every paragraph of PART 2 of the Specification.
        - b) Column two: Manufacturer's certified value confirming the product meets the specified value/feature.
        - c) Name of the nationally recognized testing laboratory that preformed the tests.
        - d) Warranty information.
      - 3) Data in the Product Data Sheet closing:
        - a) Signature of the manufacturer's official (printed and signed).
        - b) Title of the official.
      - 4) Date of signature.



- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 33 04 for requirements for:
    - a. The mechanics and administration of submittal process.
    - b. The content of the Operation and Maintenance Manuals.
  - 2. Warranty.

## **1.5 WARRANTY**

- A. Minimum of a five (5) year Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Standards: IEEE C62.41.1, IEEE C62.41.2, IEEE C62.45, NEMA LS 1, MIL-STD 220B, UL 1283, UL 1449.

### **2.2 SPD**

- A. Product:
  - 1. Externally mounted next to panelboards.
  - 2. Hybrid solid-state high performance suppression system.
    - a. Do not use suppression system with gas tubes, spark gaps or other components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
  - 3. Do not connect multiple SPD modules in series to achieve the specified performance.
  - 4. Designed for parallel connection.
  - 5. Enclosure:
    - a. Metallic NEMA 4.
  - 6. Field connection:
    - a. Mechanical or compression lugs for each phase, neutral and ground that will accept #10 through #1/0 conductors.
  - 7. Device monitor:
    - a. Long-life, solid state, externally visible indicators and Form C dry contact(s) that monitor the on-line status of each mode of the units suppression filter system or power loss in any of the phase.
    - b. A fuse status only monitor system is not acceptable.
  - 8. Accessories (when specifically specified): Unit mounted disconnect switch.
- B. Operating Voltage: Nominal unit operating voltage and configuration as indicated on the Drawings.
- C. Modes of Protection: All modes.
  - 1. Three phase (delta): L-L, L-G.
  - 2. Three phase (wye): L-N, L-L, L-G and N-G.
  - 3. Single phase (2 pole): L-L, L-N, L-G and N-G.
  - 4. Single phase: L-N, L-G and N-G.
- D. Maximum Continuous Operating Voltage: Less than 130 PCT of system peak voltage.
- E. Operating Frequency: 45 to 65 Hz.
- F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.
- G. Maximum Surge Current: 240,000 A per phase, 120,000 A per mode minimum.
- H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High waveform impulses with no degradation of more than 10 PCT deviation of the clamping voltage.

- I. SPD Protection:
  1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
  2. An IEEE C High waveforms shall not cause the fuse to open and render the SPD inoperable.
- J. Maximum Clamping Voltages: Dynamic test at the 90 degree phase angle including 6 IN lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41		UL 1449
		C High V & I Wave	B Combination Wave	
L-L < 250 V L-N < 150 V	L-L	1470 V	1000 V	800 V
	L-N	850 V	600 V	500 V
	L-G	1150 V	800 V	600 V
	N-G	1150 V	800 V	600 V
L-L > 250 V L-N > 150 V	L-L	2700 V	2000 V	1800 V
	L-N	1500 V	1150 V	1000 V
	L-G	2000 V	1550 V	1200 V
	N-G	2000 V	1550 V	1200 V

- K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

## 2.3 SOURCE QUALITY CONTROL

- A. SPD approvals and ratings shall be obtained by manufacturers from nationally recognized testing laboratories.
- B. The SPD are to be tested as a complete SPD system including:
  1. Integral unit level and/or component level fusing.
  2. Neutral and ground shall not be bonded during testing.
  3. 6 IN lead lengths.
  4. Integral disconnect switch when provided.
- C. The “as installed” SPD system including the manufacturers recommended circuit breaker, the SPD is connected to, will not open when tested with a IEEE C3 combination waveform.
- D. Tests to be performed in accordance with IEEE C62.45:
  1. Clamping voltage performance testing using IEEE C62.41 Category waveforms.
  2. Single pulse surge current capacity test.
  3. Repetitive surge current capacity testing.
  4. Spectrum analysis for EMI-RFI noise rejection.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. SPD:
  1. Mounting options:
    - a. On wall or support structure adjacent to the equipment to be protected with leads routed through conduit. .
  2. Install leads as short and straight as possible.

3. Maximum lead length: 5 FT.
4. Minimum lead size:
  - a. #10 stranded AWG.
5. When conduit connection is used, provide a minimum of four (4) twists per foot in the lead conductors and install in NFPA 70 sized conduit.
6. Connect leads to the equipment to be protected by one (1) of the following means:
  - a. Through a circuit breaker or molded case switch mounted in the equipment.
    - 1) Use manufacturer recommended circuit breaker size.
  - b. Directly to the protected equipment bus, when SPD has integral disconnect switch.
  - c. To the load side of field mounted equipment's local disconnect switch.
    - 1) Provide taps or lugs as required to provide a UL and NFPA 70 compliant connection.

## **END OF SECTION**

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**SECTION 26 50 00**  
**INTERIOR AND EXTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Interior building and exterior building mounted luminaires.
    - b. Exterior and site luminaires.
    - c. LEDs.
    - d. Drivers.
    - e. Light poles.
    - f. Low voltage lighting control systems
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Division 03 - Concrete.
  - 4. Section 26 05 00 - Electrical: Basic Requirements.
  - 5. Section 26 05 19 - Wire and Cable - 600 Volt and Below.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American National Standards Institute (ANSI):
    - a. C78.377, Specification for the Chromaticity of Solid State Lighting Products.
  - 2. Federal Communications Commission (FCC):
    - a. Code of Federal Regulations (CFR), 47 CFR 18, Industrial, Scientific and Medical Equipment.
  - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
  - 4. Illuminating Engineering Society of North America (IESNA):
    - a. LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products.
    - b. LM-80, Measuring Lumen Maintenance of LED Light Sources.
  - 5. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000Volts Maximum).
    - b. 410, Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts.
    - c. LE 4, Recessed Luminaires, Ceiling Compatibility.
  - 6. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
    - a. C82.4, Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type).
    - b. C82.11, High-Frequency Fluorescent Lamp Ballasts - Supplements.
    - c. SSL 1, Electronic Drivers for LED Devices, Arrays and Systems.
  - 7. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
    - b. 101, Life Safety Code.
  - 8. Underwriters Laboratories, Inc. (UL):
    - a. 248-4, Low-Voltage Fuses - Part 4: Class CC Fuses.
    - b. 844, Standard for Luminaires for Use in Hazardous (Classified) Locations.
    - c. 924, Standard for Emergency Lighting and Power Equipment.
    - d. 935, Standard for Fluorescent-Lamp Ballasts.

- e. 1012, Power Units Other Than Class 2.
- f. 1029, Standard for High-Intensity-Discharge Lamp Ballasts.
- g. 1310, Class 2 Power Units.
- h. 1598, Luminaires.
- i. 8750, Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- 9. United States Department of Energy (USDOE):
  - a. EAct, the National Energy Policy Act.

### 1.3 DEFINITIONS

- A. Useful Life for LED luminaire light sources:
  - 1. The operating hours before reaching 70 PCT of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions.
  - 2. This is also known as 70 PCT "Rated Lumen Maintenance Life" as defined in IESNA LM-80.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. Identify luminaire by Luminaire Schedule designation.
    - c. Luminaire data sheet:
      - 1) Name of manufacturer.
      - 2) Complete order information (catalog number).
      - 3) Description of construction and optics.
      - 4) Total input wattage.
      - 5) Luminous efficacy (lumens/Watt).
      - 6) Photometric performance data including candlepower distribution and coefficient of utilization (CU) table.
      - 7) Dimensional size.
      - 8) Weight.
      - 9) UL nameplate data for luminaires used in Class 1, Division 1 and 2 areas.
      - 10) Effective Projected Areas (EPA) for pole mounted luminaires.
    - d. Solid state Luminaire additional data:
      - 1) Voltage.
      - 2) Initial and IES L70 lumens.
      - 3) Luminous efficacy (lumens/Watt).
      - 4) Correlated Color Temperature (CCT).
      - 5) Color Rendering Index (CRI).
      - 6) Total Harmonic Distortion (THD).
      - 7) Lamp life.
      - 8) Driver manufacturer and model number.
      - 9) Driver life.
      - 10) Driver type (0-10V, constant voltage, constant current).
      - 11) Dimming range and control device compatibility.
      - 12) Remote driver: Maximum wire length to luminaire.
      - 13) Emergency battery driver:
        - a) Compatibility with lighting module.
        - b) Lumen output of lighting module in emergency operation.
        - c) Battery life.
        - d) Description of testing.
        - e) Ambient operating temperature.
      - 14) Toxicity Characteristic Leaching Procedure (TCLP) compliance.

- 15) DesignLights Consortium (DLC) Listing.
- 16) Warranty information.
- e. Pole data sheet:
  - 1) Name of manufacturer.
  - 2) Complete order information (catalog number).
  - 3) Description of construction.
  - 4) Length, shaft size and thickness.
  - 5) Wind loading (available luminaire EPA per wind speed).
  - 6) Anchor bolt template.
  - 7) Bolt size and material.
- f. Lighting Controls
  - 1) Provide fabrication and/or lay out drawings including wiring diagrams for all components including, but not limited to, control modules and panels, and low voltage lighting control stations components.
  - 2) One line diagram of system configuration
- g. See Specification Section 26 05 00 for additional requirements.
- 3. Test Reports:
  - a. IESNA LM-79 Test Report for Solid-State Luminaire.
  - b. IESNA LM-80 Test Report Solid-State Light Source.
- 4. Certifications: Solid-state Luminaire Useful Life Certificate.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
    - b. Submittal data for each component covered by warranty.
    - c. Warranty.

## 1.5 WARRANTY

- A. Minimum of a five (5) year Warranty from date of manufacture against failure for solid-state luminaire including LED arrays, LED drivers and integral control devices. The solid-state product is considered defective if more than 15 PCT of the individual light emitting diodes fail to illuminate.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Luminaires: Per Luminaire Schedule or equal.
  - 2. Solid State Light Sources:
    - a. Cree.
    - b. Xicato.
    - c. Luminaire manufacturer's proprietary system.
  - 3. LED Driver: Luminaire manufacturer's standard.
  - 4. Emergency ballasts:
    - a. Iota Engineering.
    - b. Philips Bodine.
  - 5. Poles: Luminaire manufacturer's standard.
  - 6. Low Voltage lighting control system and components
    - a. nLight, Acuity Brand
    - b. nLight Air
    - c. Sensor Switch
    - d. Or approved equal

## 2.2 GENERAL REQUIREMENTS

- A. All Luminaires and Electrical Components:
  - 1. UL labeled.
  - 2. Luminaires complete with LED modules and drivers.
- B. No live parts normally exposed to contact.
- C. When intended for use in wet areas: Mark luminaire "Suitable for wet locations."
- D. When intended for use in damp areas: Mark luminaire "Suitable for damp locations" or "Suitable for wet locations."

## 2.3 LUMINAIRES

- A. Standards and Listings:
  - 1. DesignLights Consortium (DLC).
  - 2. UL 1598.
- B. Housings:
  - 1. As indicated in the Luminaire Schedule and the following:
    - a. Extruded aluminum housings, where scheduled, shall be at least 1/8 IN thick.
    - b. Punch and form housings prior to finishing (post-paint).
- C. Castings:
  - 1. As indicated in the Luminaire Schedule and the following:
    - a. Uniform quality, free from imperfections affecting strength and appearance.
    - b. Exterior surfaces, if not receiving a finish coat, shall be smooth and match adjacent surfaces. At least one coat of clear methacrylate lacquer shall be applied unless a painted finish is specified.
- D. Fasteners:
  - 1. As indicated in the Luminaire Schedule and the following:
    - a. Aluminum or steel luminaires: Cadmium-plated or an equivalent.
    - b. Stainless steel luminaires: Stainless steel.
    - c. Bronze luminaires: Bronze or stainless steel.
    - d. Non-metallic luminaires: Stainless steel.
- E. Finishes:
  - 1. As indicated in the Luminaire Schedule and the following:
    - a. Painted surfaces:
      - 1) Manufacturer's standard metal pretreatment and baked or air-dried, light-stabilized enamel finish; acrylic, alkyd, epoxy, polyester or polyurethane.
      - 2) White finishes shall have minimum 85 PCT reflectance.
    - b. Unpainted surfaces:
      - 1) Interior: Clear anodic coating, satin finish.
      - 2) Exterior: Clear anodic coating.
- F. Gaskets:
  - 1. As Indicated in the Luminaire Schedule and the Following:
    - a. Gaskets at face plates or frames of recessed luminaires which serve as ceiling trim and which allow interior access.
    - b. Moisture seal gaskets at exterior locations and in other designated wet areas.
    - c. Secure frames to luminaire bodies with screws or other means, to result in tight installation, without light leaks.
- G. Mounting Accessories:
  - 1. Provide appropriate mounting accessories for each luminaire, compatible with various structural conditions encountered.
  - 2. All luminaires with adjustable beam angles shall have a locking device to ensure that the beam distribution is not effected during relamping or cleaning.



3. Luminaire Suspension Material:
  - a. Unfinished Spaces:
    - 1) 1/2 IN minimum diameter swivel stem, unless otherwise noted.
    - 2) Safety chain on high bay type.

## 2.4 SOLID-STATE LUMINAIRES - ADDITIONAL REQUIREMENTS

- A. Standards:
  1. IESNA LM-79, IESNA LM-80.
  2. NEMA SSL 1.
  3. UL 1012, 1310, and 8750.
  4. UL 844 for hazardous locations.
- B. Solid state modules and driver to be provided and warrantied by luminaire manufacturer.
- C. Solid-State Modules:
  1. Uniform color temperature of 4000K unless otherwise noted on the Luminaire schedule.
    - a. Color temperature measurement shall have a maximum 3 SDCM on the MacAdam Ellipse for frosted lensed luminaires, and 2 SDCM for other luminaire types (ANSI C78.377).
  2. Minimum color rendering index (CRI) of 80.
  3. LED module light output and efficacy: Measured in accordance with IESNA LM-79 standards.
  4. LED useful life and lumen maintenance: Measured in accordance with IESNA LM-80 standards.
  5. Driver and LED module: Minimum useful life of 50,000 HRS (L70).
  6. Individual LEDs connected such that a failure of one LED will not result in a light output loss of the entire luminaire.
- D. Driver:
  1. Compatible with solid-state modules and control devices specified.
  2. Operate from 60 Hz input source of 120V through 277V with sustained variations of +/- 10 PCT (voltage and frequency).
  3. Input current Total Harmonic Distortion (THD): Less than 20 PCT when operated at nominal line voltage.
  4. Power Factor: Greater than 0.90.
  5. Avoid interference with infrared devices and eliminate visible flicker.
  6. Comply with ANSI C62.41 Category A for Transient protection.
  7. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
  8. Dimmable drivers capable of continuous dimming over a range of 100 PCT to 1 PCT of rated lumen output. Dimming controlled by a 0-10VDC signal, unless otherwise specified in Luminaire Schedule.
  9. Control device must be compatible with type of driver, and coordinated prior to submission of Shop Drawings. List of compatible dimming controllers must include the range of perceived brightness. No visible flicker throughout the dimming range.
  10. Remote-mounting:
    - a. Provide maximum allowable distances for secondary wire runs to luminaires.
    - b. Provide remote mounting hardware and enclosures as required.
  11. Operating temperature range must be suitable for site temperature conditions within exterior and gasketed luminaires.
- E. Emergency Battery Driver:
  1. UL 924.
  2. Confirm compatibility with LED modules utilized.
  3. Consist of a high temperature, maintenance-free nickel cadmium battery, charger and electronic circuitry.

4. A solid state charging indicator light to monitor the charger and battery.
  5. Single-pole test switch.
- F. Luminaire properly heat sunk to assure LED junction temperature ratings are not exceeded.
1. Provide ambient operating temperature range for which product is warranted.

## **2.5 POLES**

- A. As Indicated in the Luminaire Schedule and the Following:
1. Designed for attached luminaire EPA with a 70 mph maximum wind velocity at the base with a 1.3 wind gust factor.
  2. Additional features:
    - a. Grounding lug accessible at handhole.
    - b. Galvanized anchor bolts.
    - c. Anchor bolt covers.

## **2.6 LOW VOLTAGE LIGHTING CONTROLS**

- A. System Requirements
1. Lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
  2. System Wall Switches and Dimmers (Lighting Control Station)
    - a. Communication and low voltage power shall be delivered to each device via standard network or control cabling with compatible connectors.
    - b. All devices shall provide toggle switch control.
    - c. Devices with dimming control outputs can control 0 to 10 VDC dimmable drivers compatible with specified light fixtures.
    - d. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
    - e. Devices shall be rated for low temperature, high humidity applications.

## **2.7 MAINTENANCE MATERIALS**

- A. Furnish a minimum of 2 or 10 PCT of total of each type and wattage of lamps, whichever is greater.
- B. Furnish a minimum of 10 PCT of total of each type and amperage of fuses for fixtures indicated to be fused.
- C. Spare parts are to be stored in a box clearly labeled as to its contents.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Coordinate Luminaire Types with Ceiling Construction:
1. Provide mounting hardware for the ceiling system in which the luminaire is to be installed.
- B. Fasten luminaires supported by suspended ceiling systems to ceiling framing system with hold down clips.
- C. Provide mounting brackets and/or structural mounting support for wall-mounted luminaires.
1. Do not support luminaire from conduit system.
  2. When luminaire is supported from outlet boxes, install per NFPA 70.
  3. Supports for luminaire mounted on exterior walls shall not be attached to exterior face of the wall.

- D. Support surface mounted luminaires from the building structure and not from the ceiling suspension system.
- E. Provide pendant luminaires with swivel hangers which will allow luminaire to swing in any direction but will not permit stem to rotate.
  - 1. Secure low and high bay luminaires with safety chain or safety aircraft cable to the building structure.
- F. Mount luminaire at heights indicated in Specification Section 26 05 00 or per Luminaire Schedule or as indicated on the Drawings.
- G. Install exterior luminaires so that water cannot enter or accumulate in the wiring compartment.
- H. Ground luminaires.

### **3.2 POLE INSTALLATION**

- A. Drawings Indicate the Intended Location of Light Pole:
  - 1. Field conditions may affect actual location.
  - 2. Coordinate location with all existing or new utilities and pavement.
- B. Anchor Base Plated Poles:
  - 1. Mounted on cast-in-place foundations, as detailed on the Drawings.
    - a. Concrete and reinforcing steel, in accordance with Division 03 Specification Sections.
  - 2. Protect pole finish during installation.
    - a. Repair damage to pole finish with manufacturer approved repair kit.
- C. Ground poles as indicated on the Drawings.
- D. Conductors:
  - 1. See Specification Section 26 05 19 for required underground conductors.
  - 2. Use interior building wire, as specified in Specification Section 26 05 19, from pole base to luminaire, #12 AWG minimum.
- E. Overcurrent and Short Circuit Protection:
  - 1. Protect each phase with a UL Class CC fuse:
    - a. Size: Three (3) times load current.
    - b. Standard: UL 248-4.
  - 2. Fuseholder:
    - a. Watertight, in-line and break-a-way style.
    - b. Accept up to a 30 A, 600 V fuse.
    - c. Neutral conductor shall utilize a fuseholder with a solid copper rod.
    - d. Conductor terminal: Adequate size for the installed conductors.

### **3.3 LIGHTING CONTROL**

- A. Install lighting control systems per manufacturer's recommendations and approved shop drawings.
- B. Provide back boxes compatible with lighting control stations.
- C. Completely program the lighting control systems. All cost associated with system programming is the responsibility of the Contractor
- D. Pre-Installation
  - 1. A trained factory representative shall visit the site and meet with the contractor, Owner and USER prior to installation of any portion of the system. The schedule meeting shall be mutually agreed upon.
- E. Programming
  - 1. A trained factory representative shall be on site to program all components of the system.
  - 2. The factory representative shall include two trips for any adjustments and/or reprogramming within the first year from the date of substantial completion.

3. Provide a copy of all programming installed for this project. The programming shall be identified by location.
  - F. Manufacturer's Field Services - After the Contractor confirms that equipment has been installed, the Contractor shall arrange to have a factory-authorized field technician to the project site for the purpose of confirming installation of the equipment and initial equipment start-up/calibration and troubleshooting.
    1. Confirm that all equipment connections are properly made.
    2. Check that equipment operates within manufacturer's tolerances.
    3. Confirm that components are fully operational.
  - G. Contractor to provide a written report outlining who was present and a brief summary of work completed
- 3.4 ADJUST AND CLEAN**
- A. Replace all inoperable lamps with new lamps prior to final acceptance.

**END OF SECTION**



# DIVISION 31

## EARTHWORK



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## **SECTION 31 10 00**

### **SITE CLEARING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Site clearing, tree protection, stripping topsoil and demolition.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 31 23 00 - Earthwork.
  - 4. Section 31 25 00 - Soil Erosion and Sediment Control.
  - 5. Section 32 91 13 - Topsoiling and Finished Grading.

#### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

#### **PART 3 - EXECUTION**

##### **3.1 PREPARATION**

- A. Protect existing trees and other vegetation to remain against damage.
  - 1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
  - 2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
  - 3. Provide temporary protection as required.
- B. Repair or replace trees and vegetation damaged by construction operations.
  - 1. Repair to be performed by a qualified tree surgeon/licensed arborist.
  - 2. Remove trees which cannot be repaired and restored to full-growth status.
  - 3. Replace with new trees of minimum 4 IN caliper or as required by local tree ordinance.
- C. Owner will obtain authority for removal and alteration work on adjoining property, as applicable.

##### **3.2 SITE CLEARING**

- A. Topsoil Removal:
  - 1. Strip topsoil to depths encountered or as specified within the soils report, 4 IN minimum.
    - a. Remove heavy growths of grass before stripping.
    - b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.
    - c. Separate from underlying subsoil or objectionable material.
  - 2. Stockpile topsoil where directed by Owner.
    - a. Construct storage piles to freely drain surface water.
    - b. Seed or cover storage piles to prevent erosion.
  - 3. Do not strip topsoil in wooded areas where no change in grade occurs.
  - 4. Borrow topsoil: Reasonably free of subsoil, objects over 2 IN DIA, weeds and roots.
- B. Clearing and Grubbing:
  - 1. Clear from within limits of construction all trees not marked to remain.
    - a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.

2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
- C. Disposal of Waste Materials:
1. Do not burn combustible materials on site.
  2. Remove all waste materials from site.
  3. Do not bury organic matter on site.

**END OF SECTION**



## **SECTION 31 23 00**

### **EARTHWORK**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Earthwork - excavation, backfilling, grading, compaction, disposal of waste and surplus materials, placing crushed stone, construction of berms, sheeting, bracing, dewatering and other Earthwork related work.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 07 26 00 - Under Slab Vapor Retarder.
  - 4. Section 31 25 00 - Soil Erosion and Sediment Control.
  - 5. 31 32 19 Geotextiles

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. C33, Standard Specification for Concrete Aggregates.
    - b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-lbf/ft<sup>3</sup>).
    - c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-lbf/ft<sup>3</sup>(2,700 kN-m/m)).
    - d. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
    - e. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method.
    - f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
    - g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
    - h. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
  - 2. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR Part 1926.650, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

##### **1.3 DEFINITIONS**

- A. Excavation:
  - 1. Consists of removal of material encountered to subgrade elevations required or indicated.
  - 2. Includes excavation of soils; pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; boulders; and rock.
- B. Foundations: Footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil or rock.
- C. Geotechnical Engineer: Independent geotechnical specialist providing field quality control for the project.
- D. Non-Structural Fill/Backfill: Soil materials placed and compacted to achieve finish grade elevations that do NOT support foundations, slabs, paving (gravel and bituminous), or other flatwork.

- E. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.
- F. Subgrade: The earth or soil layer immediately below foundation bearing elevation, subbase material, fill material, backfill material, or topsoil materials.
- G. Unauthorized Excavation:
  - 1. Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer.
    - a. Unauthorized excavation, as well as associated remedial work as directed by Engineer or Geotechnical Engineer, shall be at Contractor's expense.
  - 2. Unsuitable Soil Materials: Soil materials encountered at or below subgrade elevation of insufficient strength and stiffness to support construction as determined by the Geotechnical Engineer.

#### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  - 3. Certifications.
- B. Samples:
  - 1. Coordinate samples and testing for approval of off-site materials with the Geotechnical Engineer.
  - 2. Test reports.

#### **1.5 PROJECT CONDITIONS**

- A. Salvageable Items: Carefully remove items to be salvaged, and store on USER's premises unless otherwise directed.
- B. Dispose of waste materials, legally, off site.
  - 1. Burning, as a means of waste disposal, is not permitted.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Fill and Backfill:
  - 1. Selected material approved by Geotechnical Engineer from site excavation or from off-site borrow.
  - 2. Structural Fill:
    - a. May be low volume change cohesive or granular soil at Contractor's option.
    - b. Free of organic matter, frozen material and debris.
    - c. Low volume change cohesive soil:
      - 1) ASTM D2487 classification: CL-ML.
      - 2) Liquid limit: Less than 45.
      - 3) Maximum plasticity index: 20.
    - d. Granular soil:
      - 1) ASTM D2487 classification: GW, GP, GM, GC, SW, SP, SM or SC.
  - 3. Non-Structural Fill:
    - a. ASTM D2487 classification: GW, GP, GM, GC, SC, SW, SP, SM, CL-ML or CL.
    - b. Liquid limit: Less than 45.
    - c. Maximum plasticity index: 20].

- B. Granular Fill Under Building Floor Slabs-On-Grade, Electrical Equipment Pads, Manholes and Handholes:
  - 1. Clean, granular material.
  - 2. Less than 5 PCT fines passing the No. 200 sieve.
  - 3. ASTM C33 gradation size No. 67, 3/4 IN to No. 4 or other material acceptable to Geotechnical Engineer.
- C. Granular Fill Under Base Slabs with Pressure Relief Valves:
  - 1. Drainage material: Conform to ASTM C33, Size No. 67.
  - 2. Filter material: Conform to ASTM C33 requirements for fine aggregate.
- D. Granular Fill Under Electrical Equipment Pads, Manholes and Handholes: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33 gradation size No. 67, 3/4 IN to No. 4.
- E. Geotextile Filter Fabric: Refer to Specification Section 31 32 19.
- F. Vapor Retarder: Refer to Specification Section 07 26 00.
- G. Flowable Fill See Section 03 31 30.

## **PART 3 - EXECUTION**

### **3.1 PROTECTION**

- A. Erosion Control:
  - 1. See Specification Section 31 25 00.
  - 2. Clean paved roadways daily of any spillage of dirt, rocks or debris from vehicles and equipment entering or leaving site.
  - 3. Conduct work to minimize erosion of site. Remove eroded material washed off site.
    - a. If necessary or requested by Engineer, construct stilling areas to settle and detain eroded material.
- B. Protect existing surface and subsurface features on-site and adjacent to site as follows:
  - 1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
  - 2. Protect and maintain bench marks, monuments or other established reference points and property corners.
    - a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
  - 3. Verify location of utilities.
    - a. Omission or inclusion of utility items does not constitute nonexistence or definite location.
    - b. Secure and examine local utility records for location data.
    - c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
      - 1) If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
      - 2) Do not interrupt existing utilities serving facilities occupied by USER or others, during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.
      - 3) Obtain Owner's approval prior to disconnecting any utility service.
    - d. Repair damages to utility items at own expense.
    - e. In case of damage, notify Engineer at once so required protective measures may be taken.

4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
  - a. Protect new and existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
  - b. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
  - c. All repairs to be made and paid for by Contractor.
5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

### **3.2 SITE EXCAVATION AND GRADING**

- A. The site excavation and grading work includes the offsite disposition of all material:
  1. That exceed quantities required for earthwork on the project.
  2. That the Geotechnical engineer classifies as unclassified excavation.
  3. That the Geotechnical engineer classifies as unacceptable.
  4. That the Geotechnical engineer classifies as potentially contaminated.
- B. Excavation and Grading:
  1. Perform as required by the Contract Drawings.
  2. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
    - a. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations.
    - b. Perform other layout work required.
    - c. Replace property corner markers to original location if disturbed or destroyed.
  3. Preparation of ground surface for embankments or fills:
    - a. Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas.
    - b. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.
  4. Protection of finish grade:
    - a. During construction, shape and drain embankment and excavations.
    - b. Maintain ditches and drains to provide drainage at all times.
    - c. Protect graded areas against action of elements prior to acceptance of work.
    - d. Reestablish grade where settlement or erosion occurs.
- C. Borrow:
  1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
  2. Include cost of all borrow material in original proposal.
  3. Fill material to be approved by Geotechnical Engineer prior to placement.
- D. Construct embankments and fills as required by the Contract Drawings:
  1. Construct embankments and fills at locations and to lines of grade indicated.
    - a. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
  2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN.
    - a. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment.
    - b. Do not place material in layers greater than 8 IN loose thickness.

- c. Place layers horizontally and compact each layer prior to placing additional fill.
- 3. Compact soils as required to obtain specified density. Selection of appropriate equipment is the Contractor's responsibility.
  - a. In general, compact cohesive soils by sheepsfoot, and granular soils by pneumatic rollers, vibrators, or by other equipment as required to obtain specified density.
  - b. Control moisture for each layer necessary to meet requirements of compaction.
- E. Grading Tolerances: 1±IN or as shown on Drawings.
- F. **ROCK EXCAVATION**
  - 1. All rock excavation shall be under one classification.
  - 2. This classification shall include solid ledge rock in its natural location that requires systematic quarrying, drilling and/or blasting for its removal and also boulders that exceed 1/2 CU YD in volume.
  - 3. Rock excavation includes any material which cannot be dislodge by ad D-8 Caterpillar tractor, or equivalent, equipped with a hydraulically operated power ripper, or by a Caterpillar 330 hydraulic excavator, or equivalent, without the use of drilling or blasting.
    - a. When rock is encountered, strip free of earth.
    - b. Employ an independent surveyor to determine rock quantities before removal operation begins.
    - c. In computing the volumetric content of rock excavation for payment, the pay lines shall be taken as follows:  
All pond drainage pipe installation is assumed to include rock excavation and shall be included in the bid contract amount.
    - d. For piping and utilities: A width 18 IN wider than the outside diameter of the pipe or conduit and from rock surface to 6 IN below bottom exterior surface of the pipe or conduit.
    - e. For paving: 2 FT outside the exterior limits of paving and from rock surface to 6 IN below bottom of pavement subbase.

### 3.3 USE OF EXPLOSIVES

- A. Blasting with any type of explosive is prohibited.

### 3.4 COMPACTION DENSITY REQUIREMENTS

- A. Obtain approval from Geotechnical Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.
- B. Provide dewatering system necessary to successfully complete compaction and construction requirements.
- C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by Geotechnical Engineer.
- D. Stabilize subgrade with well graded granular materials as directed by Geotechnical Engineer.
- E. Assure by results of testing that compaction densities comply with the following requirements:
  - 1. Sitework:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Under Paved Areas, Sidewalks and Piping:		
Cohesive soils	95 PCT per ASTM D698	-2 to +3 PCT of optimum
Cohesionless soils	80 PCT relative density per ASTM D4253 and ASTM D4254	
Unpaved Areas:		

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Cohesive soils	90 PCT of ASTM D698	-2 to +3 PCT of optimum
Cohesionless soils	75 PCT relative density per ASTM D4253 and ASTM D4254	

2. Structures:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material	98 PCT per ASTM D698	-2 to +3 PCT of optimum
Outside structures next to walls, piers, columns and any other structure exterior member	95 PCT per ASTM D698	-2 to +3 PCT of optimum

3. Specific areas:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Outside structures under equipment support foundations	98 PCT per ASTM D698	-2 to +3 PCT of optimum
Under void	90 PCT per ASTM D1557	-2 to +3 PCT of optimum
Granular fill under base slabs with pressure relief valves	80 PCT relative density per ASTM D4253 and ASTM D4254 or 98 PCT of ASTM D698	
Granular fill under building floor slabs-on-grade	80 PCT relative density per ASTM D4253 and ASTM D4254	

### 3.5 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:

1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
2. Obtain fill and backfill material necessary to produce grades required.
  - a. Materials and source to be approved by Geotechnical Engineer.
  - b. Excavated material approved by Geotechnical Engineer may also be used for fill and backfill.
3. In the paragraphs of this Specification Section, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:

1. General:
  - a. Do not commence excavation for foundations for structures until Geotechnical Engineer approves:
    - 1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
    - 2) Density and moisture content of site area compacted fill material meets requirements of specifications.
    - 3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.

- 4) Surcharge or mass fill material has been removed from construction area or portions thereof.
  - b. Engineer grants approval to begin excavations.
- 2. Dimensions:
  - a. Excavate to elevations and dimensions indicated or specified.
  - b. Allow additional space as required for construction operations and inspection of foundations.
  - c. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction.
  - d. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- 3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.
  - a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Geotechnical Engineer.
  - b. Remove unsuitable subgrade soils located below foundations. The bottom of the over-excavation shall be located outside the exterior limits of foundations around the perimeter of structure the following horizontal distance, whichever is greater:
    - 1) Distance equal to depth of over-excavation below bottom of foundations.
    - 2) 5 FT.
    - 3) As directed by Geotechnical Engineer.
  - c. When excavation has reached required subgrade elevations, notify Geotechnical Engineer, who will make an inspection of conditions.
    - 1) If Geotechnical Engineer determines that bearing materials at required subgrade elevations are unsuitable, provide Subgrade Stabilization as specified herein.
- 4. Install working surface over approved subgrade.
  - a. Minimum thickness: 6".
- 5. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.
  - a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.
  - b. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to density stated in this Specification Section before fill material can be placed thereon.
  - c. Do not carry excavations lower than shown for foundations except as directed by Geotechnical Engineer or Engineer.
  - d. If any part of excavations is carried below required depth without authorization, notify Engineer and correct unauthorized excavation as directed. Corrections may include:
    - 1) Under soil supported footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
      - a) Concrete fill may be used to bring elevations to proper position.
    - 2) In locations other than those above, including slabs on grade and pile supported foundations, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Geotechnical Engineer.
    - 3) No extra compensation will be made to Contractor for correcting unauthorized excavations.
- 6. Make excavations large enough for working space, forms, damp-proofing, waterproofing, and inspection.

7. Notify Geotechnical Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected.
  - a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Geotechnical Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon.
  - b. Geotechnical Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
  - c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.
  - d. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
8. Dewatering:
  - a. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
  - b. Groundwater shall be maintained at least 3 FT below the bottom of any excavation.
  - c. Review Geotechnical investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
  - d. Employ dewatering specialist for selecting and operating dewatering system.
  - e. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.
  - f. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
    - 1) Install groundwater monitoring wells as necessary.
  - g. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
9. Subgrade stabilization:
  - a. If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by Geotechnical Engineer.
  - b. Provide compaction density of replacement material as stated in this Specification Section.
  - c. Loose, wet, or soft materials, when approved by Geotechnical Engineer, may be stabilized by a compacted working mat of well graded crushed stone.
  - d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.
  - e. Remove and replace frozen materials as directed by Geotechnical Engineer.
  - f. Method of stabilization shall be performed as directed by Geotechnical Engineer.
  - g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Geotechnical Engineer.
10. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction.
  - a. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DEGF before structure is completed and heated to a temperature of at least 50 DEGF.



11. Protection of structures:
  - a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.
  - b. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.
12. Shoring:
  - a. Shore, slope, or brace excavations as required to prevent them from collapsing.
  - b. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.
  - c. Construct shoring that is required to retain water as part of the dewatering system, using non-permeable details such as interlock sealant for sheet piles.
13. Drainage:
  - a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.
  - b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.
  - c. Provide pumping required to keep excavated spaces clear of water during construction.
  - d. Should any water be encountered in the excavation, notify Engineer and Geotechnical Engineer.
  - e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
14. Frost protection:
  - a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground.
  - b. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved.
  - c. Protect excavation from frost if placing of concrete or fill is delayed.
  - d. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
  - e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DEGF.
- C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:
  1. General:
    - a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Geotechnical Engineer and scarified to a depth of 6 IN and compacted to density specified herein.
    - b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 PCT.
    - c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Geotechnical Engineer as being free of undesirable material and compacted to specified density.
  2. Obtain approval of fill and backfill material and source from Geotechnical Engineer prior to placing the material.
  3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of granular fill unless otherwise indicated.
  4. Vapor barrier: Install a continuous vapor barrier under floor slabs-on-grade as required by Specification Section 07 26 00 and shown on Contract Drawings.
  5. Fill and backfill placement:

- a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Geotechnical Engineer.
  - b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
  - c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.
  - d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes.
    - 1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum
    - 2) Contractor is responsible for method of compaction so as not to damage wall.
  - e. Use hand operated equipment for filling and backfilling next to walls.
  - f. Do not place fill and backfill when the temperature is less than 40 DEGF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
  - g. Use vibratory equipment to compact granular material; do not use water.
6. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content as required to fill the specified over-excavation to bottom of foundation.

**D. Filling and Backfilling Outside of Structures:**

- 1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.
- 2. Provide material as approved by Geotechnical Engineer for filling and backfilling outside of structures.
- 3. Fill and backfill placement:
  - a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Geotechnical Engineer.
  - b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
  - c. Compact material with equipment of proper type and size to obtain density specified.
  - d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes.
    - 1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum
    - 2) Contractor is responsible for method of compaction so as not to damage wall.
  - e. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.
  - f. Do not place fill or backfill material when temperature is less than 40 DEGF and when subgrade to receive material is frozen, wet, loose, or soft.
  - g. Use vibratory equipment for compacting granular material; do not use water.
- 4. Backfilling against walls:
  - a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved.
  - b. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, damp-proofing and waterproofing have been completed.
  - c. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
    - 1) See Contract Drawings for specific exceptions.
  - d. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

**E. Backfilling Outside of Structures Under Piping or Paving:**

- 1. When backfilling outside of structures requires placing backfill material under piping or paving, the material shall be placed from bottom of excavation to underside of piping or

paving at the density required for fill under piping or paving as indicated in this Specification Section.

2. This compacted material shall extend transversely to the centerline of piping or paving a horizontal distance each side of the exterior edges of piping or paving equal to the depth of backfill measured from bottom of excavation to underside of piping or paving.
3. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other Specification Sections for the Project.

### **3.6 FIELD QUALITY CONTROL**

- A. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA standards 29 CFR Part 1926.650 Subpart P, and state requirements. Where conflict between OSHA and state regulations exists, the more stringent requirements shall apply.
- B. Special Inspection and Testing:
  1. See Section 01 45 33.
- C. Responsibilities of Special Inspector:
  1. Review proposed materials for fill and backfill around structures.
  2. All testing, observation and work indicated as being performed by the Geotechnical Engineer in this Specification Section.
  3. Services will include verification and documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
  4. Moisture density relations, to be established by the Geotechnical Engineer required for all materials to be compacted.
  5. Extent of compaction testing will be as necessary to assure compliance with specifications.
  6. Prepare and submit inspection and test reports to Owner.
    - a. Coordinate such work with other Special Inspectors.
  7. Test reports to include the following:
    - a. Report and certification of aggregate fill and drainage fill.
    - b. Test reports on borrow material.
    - c. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
    - d. Field reports; in-place soil density and moisture tests.
    - e. One optimum moisture-maximum density curve for each type of soil encountered.
    - f. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
    - g. Other documentation necessary for Geotechnical Engineer to approve earthwork.
    - h. Assist Owner to determine corrective measures necessary for defective work.
- D. Responsibilities of Testing Agency for Site Excavation and Grading:
  1. All testing, observation and work indicated as being performed by the Geotechnical Engineer in other than Article 3.5 of this Specification Section.
  2. Services will include verification and documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
  3. Moisture density relations, to be established by the Geotechnical Engineer required for all materials to be compacted.
  4. Extent of compaction testing will be as necessary to assure compliance with specifications.

### **END OF SECTION**

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**SECTION 31 23 33**  
**TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Excavation, trenching, backfilling and compacting for all underground utilities and all piping.
    - a. Wastewater piping.
    - b. Overflow piping.
    - c. Storm sewer piping
    - d. Process Water piping.
    - e. Water supply piping.
    - f. Sewers and drain piping.
    - g. Water piping (potable, plant, process and nonpotable).
    - h. Surface drainage conduits and piping.
    - i. Electrical ductbanks, conduits, and direct burial cables.
    - j. All related utility and process appurtenances.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Division 26 - Electrical.
  - 4. Section 31 23 00 - Earthwork.
- C. QUALITY ASSURANCE
- D. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. C33, Standard Specification for Concrete Aggregates.
    - b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
    - c. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
    - d. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
    - e. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
- E. Qualifications: Owner will hire an independent soils laboratory to conduct in-place moisture-density tests for backfilling to assure that all work complies with this Specification Section.

**1.2 DEFINITIONS**

- A. Excavation: All excavation will be defined as unclassified.
- B. Pipe Embedment or Carefully Compacted Backfill or Pipe Embedment: soils required from 4" under pipes to 12" over pipes.
- C. Final Backfill material: soils required from 12" over pipes to roadway surfaces, pavements or topsoil.
- D. Cohesive soils - GC, SC, ML, CL, MH, CH per ASTM D2321
- E. Cohesionless soils – GW, GP, SW, SP per ASTM D2321

### 1.3 SUBMITTALS

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  - 3. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
  - 4. Submit sieve analysis reports on all granular materials.
- B. Informational Submittals:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Trench shield (trench box) certification if employed:
    - a. Specific to Project conditions.
    - b. Re-certified if members become distressed.
    - c. Certification by registered professional structural engineer, registered in the state where the Project is located.
    - d. Engineer is not responsible to, and will not, review and approve.

### 1.4 SITE CONDITIONS

- A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
  - 1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.
- B. Protect against compromising any berms adjacent to the excavation while in service. Any slope disruption shall be corrected and recompacted to original condition at no additional cost to Owner.
- C. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
- D. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.
- E. Verify location of existing underground utilities.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Common Backfill (Final Backfill) Material:
  - 1. Where under structures, roads or sidewalks, provide per Section 31 23 00 Earthwork.
  - 2. Where not under structures, sidewalks, or roads, provide Cohesive soils - GC, SC, ML, CL, MH, CH per ASTM D2321 or Cohesionless soils – GW, GP, SW, SP per ASTM D2321, except finish with top soil and seeding specified in other sections.
    - a. Free of rock cobbles, roots, sod or other organic matter, and frozen material.
    - b. Moisture content at time of placement: 3 percent plus/minus of optimum moisture content as specified in accordance with ASTM D698.
- B. Subgrade Stabilization Materials: Where subgrade is not stable, provide Mirifi 600x or equal over the native material and then start the pipe embedment zone.
- C. Carefully Compacted Backfill (Pipe Embedment, Bedding, Initial backfill and Haunch):
  - 1. Class II poorly graded sand (SP) or well graded sand (SW) per ASTM D2321, compacted to no less than 85% standard proctor density.

4. Flowable fill:
  - a. Description: Flowable fill shall be a mixture of cement, fly ash, fine sand, water, and air having a consistency which will flow under a very low head.
  - b. Material characteristics:
    - 1) The approximate quantities of each component per cubic yard of mixed material shall be as follows:
      - a) Cement (Type I or II): 50 LBS.
      - b) Fly ash: 200 LBS.
      - c) Fine sand: 2,700 LBS.
      - d) Water: 420 LBS.
      - e) Air content: 10 percent.
    - 2) Actual quantities shall be adjusted to provide a yield of 1 cubic yard with the materials used.
    - 3) Approximate compressive strength should be 85 to 175 psi.
    - 4) Fine sand shall be an evenly graded material having not less than 95 percent passing the No. 4 sieve and not more than 5 percent passing the No. 200 sieve.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Remove and dispose of unsuitable materials off site unless USING AGENCY agrees to on site disposal.

### **3.2 EXCAVATION**

- A. Unclassified Excavation: Rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone are unsuitable materials unless they meet the specification of another material.
- B. Excavation for Appurtenances:
  1. 12 IN (minimum) clear distance between outer surface and embankment.
  2. See Specification Section 31 23 00 for applicable requirements.
  3. See Specification Section 33 05 16 for applicable requirements.
- C. Groundwater Dewatering:
  1. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade to allow subgrade stabilization, pipe, bedding and backfill material to be placed in the dry, and to maintain a stable trench wall or side slope.
  2. Groundwater shall be drawn down and maintained at least 3 FT below the bottom of any trench or manhole excavation prior to excavation.
  3. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
    - a. Employ dewatering specialist for selecting and operating dewatering system.
  4. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
  5. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
  6. Install groundwater monitoring wells as necessary.
  7. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
- D. Trench Excavation:
  1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
    - a. Support existing utility lines and yard piping where proposed work crosses at a lower elevation.
      - 1) Stabilize excavation to prevent undermining of existing utility and yard piping.

2. Open trench outside buildings, units, and structures:
  - a. No more than the distance between two manholes, structures, units, or 300 LF, whichever is less.
  - b. Field adjust limitations as weather conditions dictate.
3. Trenching within buildings, units, or structures:
  - a. No more than 100 LF at any one time.
4. Any trench or portion of trench, which is opened and remains idle for seven (7) calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner.
  - a. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
5. Observe following trenching criteria:
  - a. Trench size:
    - 1) Excavate width to accommodate free working space.
    - 2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:

OVERALL DIAMETER OF UTILITY SERVICE	EXCESS DIMENSION
33 IN and less	18 IN
more than 33 IN	24 IN

- 3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
- 4) Keep trenches free of surface water runoff.
  - a) Include cost in Bid.
  - b) No separate payment for surface water runoff pumping will be made.

E. Trenching for Electrical Installations:

1. Observe the preceding Trench Excavation paragraph in PART 3 of this Specification Section.
2. Modify for electrical installations as follows:
  - a. Open no more than 600 LF of trench in exterior locations for trenches more than 12 IN but not more than 30 IN wide.
  - b. Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
  - c. Do not over excavate trench.
  - d. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified or shown on Drawings.
  - e. See Division 26 for additional requirements.

F. Flowable Fill:

1. Flowable fill shall be:
  - a. Discharged from a mixer by any means acceptable to the Owner into the area to be filled.
  - b. Placed in 4 FT maximum lifts to the elevations indicated.
    - 1) Allow 12 HR set-up time before placing next lift or as approved by the Engineer.
    - 2) Contractor shall place flowable fill lifts in such a manner as to prevent flotation of the pipe.
2. Flowable fill shall not be placed on frozen ground.
3. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
4. Conform to appropriate requirements of Specification Section 31 23 00.
5. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable, and the air temperature is 34 DegF and rising.



6. At the time of placement, flowable fill must have a temperature of at least 40 DegF.
7. Mixing and placing shall stop when the air temperature is 38 DegF or less and falling.
8. Each filling stage shall be as continuous an operation as is practicable.
9. Contractor shall prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
10. Flowable fill shall not be placed until water has been controlled or groundwater level has been lowered in conformance with the requirements of the preceding Groundwater Dewatering paragraph in PART 3 of this Specification Section.

### **3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING**

- A. Over-Excavation:
  1. Backfill and compact to 90 percent of maximum dry density per ASTM D698.
  2. Backfill with granular bedding material as option.
- B. Rock Excavation:
  1. Refer to 31 23 00 for rock excavation requirements.
  2. Excavate minimum of 6 IN below bottom exterior surface of the pipe or conduit.
  3. Backfill to grade with suitable earth or granular material.
  4. Form bell holes in trench bottom.
- C. Subgrade Stabilization:
  1. Stabilize the subgrade when directed by the Engineer.
  2. Observe the following requirements when unstable trench bottom materials are encountered.
    - a. Notify Owner when unstable materials are encountered.
      - 1) Define by drawing station locations and limits.
    - b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
      - 1) Replace with subgrade stabilization with no additional compensation.

### **3.4 BACKFILLING METHODS**

- A. Do not backfill until tests to be performed on system show system is in full compliance with specified requirements.
- B. Carefully Compacted Backfill (Pipe Embedment):
  1. Furnish where indicated on Drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
  2. Comply with the following:
    - a. Place backfill in lifts not exceeding 6 IN (loose thickness).
    - b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
    - c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
    - d. Compact each lift to specified requirements.
- C. Common Trench Backfill:
  1. Perform in accordance with the following:
    - a. Place backfill in lift thicknesses capable of being compacted to densities specified.
    - b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
    - c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.
- D. Water flushing for consolidation is not permitted.
- E. Backfilling for Electrical Installations:
  1. Observe the preceding Carefully Compacted Backfill paragraph or Common Trench Backfill paragraph in PART 3 of this Specification Section or when approved by the Engineer.
  2. Modify for electrical installation as follows:

- a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

### 3.5 COMPACTION

- A. General:
  1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
  2. In no case shall degree of compaction below minimum compactions specified be accepted.
- B. Compaction Requirements:
  1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.
    - a. Carefully compacted backfill (Pipe Embedment): See Part 2.
    - b. Common trench backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
Under pavements, roadways, surfaces within highway right-of-ways	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohesionless soils	75 percent of relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded, plant seeded, nontraffic areas	Cohesive soils	90 percent of maximum dry density by ATM D698
	Cohesionless soils	60 percent of relative density by ASTM D4253 and ASTM D4254

### 3.6 FIELD QUALITY CONTROL

- A. Testing:
  1. Perform in-place moisture-density tests as directed by the Geotechnical Engineer.
  2. Perform tests through recognized testing laboratory approved by Owner.
  3. Costs of "Passing" tests paid by Contractor.
  4. Costs associated with "failing" tests shall be paid by Contractor.
  5. Perform additional tests as directed until compaction meets or exceeds requirements.
  6. Reference to Engineer in this Specification Section will imply Geotechnical Engineer and directed by Owner to undertake necessary inspections as approvals as necessary.
  7. Assure Testing Agency has immediate access for testing of all soils related work.
  8. Ensure excavations are safe for testing personnel.

### END OF SECTION

**SECTION 31 25 00**  
**SOIL EROSION AND SEDIMENT CONTROL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Soil erosion and sediment control.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Erosion control standards: Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas by the United States Department of Agriculture (USDA), Soil Conservation Service, College Park, Maryland
  - 2. Maine Erosion and Sediment Control Best Management Practices (BMPs) Manual for Designers and Engineers.
- B. SUBMITTALS
  - 1. Shop Drawings:
    - a. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
    - b. Product technical data including:
      - 1) Acknowledgement that products submitted meet requirements of standards referenced.
      - 2) Manufacturer's installation instructions.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Silt Fence.
- B. Grass Seed: Annual ryegrass.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Prior to General Stripping Topsoil and Excavating:
  - 1. Install perimeter silt fence according to manufacturer specifications.
  - 2. Install straw bales or filter socks as needed and at existing open grate manholes.
    - a. Provide two stakes per bale.
    - b. First stake angled toward previously installed bale to keep ends tight against each other.
- B. Temporarily seed topsoil stockpiles:
  - 1. Rate: 1/2 LB/1000 SQFT.
  - 2. Reseed as required until good stand of grass is achieved.

**3.2 DURING CONSTRUCTION PERIOD**

- A. Maintain Silt Fence, Straw Bales, etc.:
  - 1. Inspect regularly especially after rainstorms.

- 2. Repair or replace damaged or missing items.
- B. After rough grading, sow temporary grass cover over all exposed earth areas.
- C. Construct inlets as soon as possible.
  - 1. Excavate and tightly secure straw bales completely around inlets as detailed on Drawings.
- D. Provide necessary swales and dikes to direct all water towards and into the existing vegetated drainage swale.
- E. Do not disturb existing vegetation (grass and trees).
- F. Remove sediment from behind bales to prevent overtopping.
- G. Topsoil and Fine Grade Slopes and Swales, etc.: Seed and mulch as soon as areas become ready.

### **3.3 NEAR COMPLETION OF CONSTRUCTION**

- A. Grade to finished or existing grades.
- B. Fine grade all remaining earth areas, then seed and mulch.

### **END OF SECTION**

## **SECTION 31 32 19**

### **GEOTEXTILES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Nonwoven geotextile material.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. D3786, Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
    - b. D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
    - c. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
    - d. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
    - e. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
    - f. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
    - g. D4759, Standard Practice for Determining the Specification Conformance of Geosynthetics.
    - h. D4873, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
    - i. D6241, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile- Related Products Using a 50-mm Probe
- B. Qualifications:
  - 1. Manufacturer shall demonstrate five (5) years continuous experience, including a minimum of 10,000,000 SF of geotextile installation in the past three (3) years.
  - 2. Installer Foreman shall demonstrate installation of a minimum of 1,000,000 SF of geotextile in the capacity of Foreman.
  - 3. Installer Foreman shall attend pre-installation conference.

##### **1.3 DEFINITIONS**

- A. Manufacturer:
  - 1. Manufacturer producing geotextile sheets from resin and additives.
- B. Installer:
  - 1. The Installer Firm is the construction firm that performs the hands-on work in the field.
  - 2. The Installer Foreman is the individual who has on-site supervisory responsibility for the Installer Firm's field crew.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Qualification documentation specified in the QUALITY ASSURANCE Article in PART 1 of this Specification Section.

3. Manufacturer's documentation that raw materials and roll materials comply with required geotextile physical properties.
4. Manufacturer and Installer quality control manuals.
5. Original test results for resins, roll material and factory seam tests at frequency specified in respective quality control manuals.
  - a. Results shall include or bracket the rolls delivered for use in the Work.
6. Geotextile layout plan with proposed size, number, position and sequencing of geotextile rolls and direction of all field seams.
7. Proposed details of anchoring and overlapping if different than included in Contract Documents.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Label, handle, and store geotextiles in accordance with ASTM D4873 and as specified herein.
- B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage.
  1. Do not remove the plastic wrapping until deployment.
- C. Label each roll with the manufacturer's name, geotextile type, lot number, roll number, and roll dimensions (length, width, gross weight).
- D. Repair or replace geotextile or plastic wrapping damaged as a result of storage or handling, as directed.
- E. Do not expose geotextile to temperatures in excess of 71 DegC (160 DegF) or less than 0 DegC (32 DegF) unless recommended by the manufacturer.
- F. Do not use hooks, tongs or other sharp instruments for handling geotextile.
  1. Do not lift rolls lifted by use of cables or chains in contact with the geotextile.
  2. Do not drag geotextile along the ground.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. GSE Lining Technology.
  2. Propex Geosynthetics.
  3. SKAPS Industries.
  4. TenCate Mirafi.
  5. Tenax.

### **2.2 MATERIALS AND MANUFACTURE**

- A. Geotextile:
  1. Nonwoven pervious sheet of polymeric material.
  2. Geotextile fibers:
    - a. Long-chain synthetic polymer composed of at least 85 percent by weight polyolefins, polyesters, or polyamides.
    - b. Filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure.
    - c. Do not as reclaimed or recycled fibers or polymer to the formulation.
  3. Form geotextile into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages.
  4. The geotextile physical properties shall equal or exceed the minimum average roll values listed below.
    - a. Values shown are for the weaker principal direction.

PROPERTY	TEST METHOD	MINIMUM AVERAGE ROLL VALUE
Mass per Unit Area, OZ/SY	ASTM D5261	8
AOS, U.S. Standard Sieve	ASTM D4751	80
Permittivity, SEC-1	ASTM D4491	1.5
Grab Tensile, LBS	ASTM D4632	205
Trapezoidal Tear, LBS	ASTM D4533	85
CBR Puncture, LB	ASTM D6241	595
Ultraviolet Degradation % retained @ 500 HRS	ASTM D4355	70
Sewn Seam Strength, LBS	ASTM D4632	205

B. Thread:

1. High-strength polyester, nylon, or other approved thread type.
2. Equivalent chemical compatibility and ultraviolet light stability as the geotextile.
3. Contrasting color with the geotextile.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Construct the surface underlying the geotextiles smooth and free of ruts or protrusions which could damage the geotextiles.

### 3.2 INSTALLATION

- A. Install geotextiles in accordance with manufacturer's written recommendations.
- B. Hand place geotextile.
1. No equipment will be permitted to traffic in direct contact with the geotextile.
- C. Lay geotextile smooth so as to be free of tensile stresses, folds, and wrinkles.
- D. Heat tack the geotextile overlaps as shown on the Drawings.
- E. Backfill anchor trenches in accordance with Specification Section 31 23 00.
- F. Place cover soil in accordance with Specification Section 31 23 00.
- G. Protect geotextiles from clogging, tears, and other damage during installation.
- H. Geotextile Repair:
1. Place a patch of the same type of geotextile which extends a minimum of 12 IN beyond the edge of the damage or defect.
  2. Fasten patches continuously using a sewn seam or other approved method.
  3. Align machine direction of the patch with the machine direction of the geotextile being repaired.
  4. Replace geotextile which cannot be repaired.
- I. Use adequate ballast (e.g., sand bags) to prevent uplift by wind.
- J. Do not use staples or pins to hold the geotextile in place.
- K. Do not leave geotextile uncovered for more than 14 days.

### 3.3 FIELD QUALITY CONTROL

- A. Provide as-constructed drawing showing roll number; layout; joint locations; and destructive sample repair, and patch locations.

## END OF SECTION

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## DIVISION 32

### EXTERIOR IMPROVEMENTS



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**SECTION 32 12 16**  
**ASPHALTIC CONCRETE VEHICULAR PAVING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Asphaltic concrete vehicular paving.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Federal Specifications (FS):
    - a. TT-P-1952F, Paint, Traffic and Airfield Marking, Waterborne.
  - 2. Construction standards and Specifications: State of Maine, Department of Transportation, "Road and Bridge Standards and Specifications," 2016, as amended to date.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Asphalt design mix.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Hot Mix Asphalt (HMA) per Section 211 of the MDOT Specifications.
- B. Line Paint:
  - 1. Nonreflective.
  - 2. White and yellow.
  - 3. FS TT-P-1952F.
  - 4. Thermoplastic.

**2.2 MIXES**

- A. Comply with mix design category HMA of the VDOT Specification Section 211.

**PART 3 - EXECUTION**

**3.1 APPLICATION**

- A. Construct to line, grade and section as shown on Drawings and in accordance with referenced State Specifications.
- B. Install a 3 IN compacted layer of asphaltic base course in accordance with the referenced State Specifications.

- C. Spread a prime coat uniformly on compacted aggregate base course at rate of 0.05 to 0.10 GAL per square yard in accordance with Section 211 of the VDOT Specifications.
- D. Install a 3 IN surface course in accordance with VDOT Specifications.
- E. Tolerance of Finished Grade: +0.10 FT from required elevations.

**END OF SECTION**

**SECTION 32 15 40**  
**CRUSHED STONE SURFACING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Crushed Stone surfacing.
    - a. Drainage outflow area.
    - b. Slope rip rap.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 32 91 13 – Topsoiling and Finished Grading.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Association of State Highway and Transportation Officials (AASHTO):
    - a. T2, Sampling Stone, Slag, Gravel, Sand and Stone Block for Use as Highway materials.
  - 2. ASTM International (ASTM):
    - a. C29, Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate.
    - b. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
    - c. D75, Standard Practice for Sampling Aggregates.
    - d. D5821, Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

**1.3 SUBMITTALS**

- A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- B. Product Data:
  - 1. Acknowledgement that products submitted meet requirements of standards referenced.
  - 2. Sieve analysis reports on all granular materials.
  - 3. Source tests: submit certified test reports and service records to determine acceptability and application of stone materials.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Crushed Stone Surfacing:
  - 1. Fractured Faces: ASTM D5821 - 85% of the rock shall be fractured on all faces.
  - 2. Electrical Resistivity: Minimum 3,000 ohm-meters.
  - 3. DMSO Loss: ASTM DMSO - Maximum 12%.
  - 4. Bulk Density: ASTM C29 – Minimum 80 PCF.
  - 5. Gradation: ASTM C136 as defined below:

Sieve Size	1 IN	3/4 IN	3/8 IN	No. 4	No. 8
Percent Passing by Weight	100	50	5 to 10	4 to 9	0 to 2

## **2.2 SOURCE QUALITY CONTROL**

- A. Furnish material from a single source.
- B. Obtain samples per ASTM D75 from a local quarry that typically provides material to meet the specification requirements.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Trim and dress all areas to required cross sections.
- B. Bring areas that are below allowable minus tolerance limit to grade by filling with material similar to adjacent material.
- C. Compact to density specified for backfill in accordance with Specification Section 31 23 00.
- D. Do not place any stone on soft, muddy, or frozen material.
- E. Prevent contamination of existing surfacing stone during excavation activities.
- F. Do not place any stone material on prepared base prior to approval by Owner.

### **3.2 PLACING**

- A. Place to required thickness and grades:
  - 1. Depth: minus 0 inches, plus 2 inches.
- B. Place to full thickness in a single operation to avoid displacing the underlying material.
- C. Compact material to a firm uniform layer.
- D. Maintain a neat and dust-free finish surface.

**END OF SECTION**

## **SECTION 32 31 13**

### **CHAIN LINK FENCE AND GATES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Chain link fencing and gates.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 31 23 00 - Earthwork.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - b. A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
    - c. A824, Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain-Link Fence.
    - d. F552, Standard Terminology Relating to Chain Link Fencing.
    - e. F567, Standard Practice for Installation of Chain-Link Fence.
    - f. F626, Standard Specification for Fence Fittings.
    - g. F900, Standard Specification for Industrial and Commercial Steel Swing Gates.
    - h. F1043, Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework.
    - i. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
  - 2. American Welding Society (AWS).
  - 3. National Fire Protection Association (NFPA):
    - a. NFPA 70, National Electrical Code (NEC).
  - 4. Underwriters Laboratories, Inc. (UL).
- B. Qualifications:
  - 1. Installer bonded and licensed in the Project state.
  - 2. Installer shall have a minimum two years experience installing similar fencing.
  - 3. Utilize only AWS certified welders.
  - 4. Electric gate operators to be UL listed.
  - 5. Grounding by an electrician licensed in Project state.

##### **1.3 DEFINITIONS**

- A. See ASTM F552.
- B. NPS: Nominal pipe size, in inches.
- C. Installer or Applicator:
  - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  - 2. Installer and applicator are synonymous.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.

2. Scaled plan layout showing spacing of components, accessories, fittings, and post anchorage.
3. Mill certificates.
4. Source quality control test results.
5. Automatic gate system:
  - a. Electrical circuitry and control wiring.
  - b. Intercom system.
  - c. Detector loop layout.
  - d. Locking plan.
  - e. Method of installation of detector loop.
  - f. Sealant material for detector loops.

## **PART 2 - PRODUCTS**

### **2.1 COMPONENTS**

- A. Chain Link Fabric:
  1. Fabric type:
    - a. ASTM A392 zinc-coated steel:
      - 1) Coated before weaving, 2.0 oz/SQFT.
    - b. PVC-coated steel:
      - 1) ASTM F668, Class 2B.
      - 2) Galvanized core wire, ASTM A641, Class 3.
  2. Wire gage:
    - a. Oxygen pad gage: 6
    - b. Bird netting gage: 9
  3. Mesh size:
    - a. Oxygen pad: 2 inches.
    - b. Bird netting: 1 inch.
  4. Selvage treatment:
    - a. Top: Twisted and barbed.
    - b. Bottom: Knuckled.
- B. Concrete:
  1. ASTM C150 Type I.
  2. 1 inches maximum size aggregate (ASTM C33).
  3. Clean water.
  4. Minimum 28-day compressive strength of 2500 psi.
  5. Not less than four sacks of cement per cubic yard.
  6. 3 inches minimum slump.
  7. 2 to 4% entrained air.
- C. Line Post:
  1. ASTM F1083 pipe:
    - a. Schedule 40, NPS 2.
- D. Corner or Terminal Posts:
  1. ASTM F1083 pipe:
    - a. Schedule 40, NPS 2-1/2.
- E. Brace and Rails:
  1. ASTM F1083 pipe:
    - a. Schedule 40, NPS 1-1/4.
- F. Tension Wire:
  1. Top and bottom of fabric:
    - a. ASTM A824, galvanized steel, Class 3.



- G. Fence Fittings (Post and Line Caps, Rail and Brace Ends, Sleeves-Top Rail, Tie Wires and Clips, Tension and Brace Bands, Tension Bars, Truss Rods):
  - 1. ASTM F626.
- H. Swing Gate:
  - 1. ASTM F900.
  - 2. Materials as specified for fence framework and fabric.
  - 3. Hardware:
    - a. Galvanized per ASTM A153/A153M.
    - b. Hinges to permit 180 degrees inward gate opening.
- I. Sliding Gate:
  - 1. ASTM F1184.

## **2.2 SOURCE QUALITY CONTROL**

- A. Test related fence construction materials to meet the following standards:
  - 1. Posts and rails: ASTM F1043, Heavy Industrial.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with:
  - 1. Manufacturer's instructions.
  - 2. Lines and grades shown on Drawings.
  - 3. ASTM F567.
- B. Do not start fence installation before final grading is complete and finish elevations are established.
- C. Drill holes in firm, undisturbed or compacted soil.
- D. Place fence with bottom edge of fabric at maximum clearance above grade, as shown on Drawings.
  - 1. Correct minor irregularities in earth to maintain maximum clearance.
- E. Space line posts at equal intervals not exceeding 10 feet on-center.
- F. Provide post braces for each gate, corner, pull and terminal post and first adjacent line post.
- G. Install tension bars full height of fabric.
- H. Rails:
  - 1. Fit rails with expansion couplings of outside sleeve type.
  - 2. Rails continuous for outside sleeve type for full length of fence.
- I. Provide expansion couplings in top rails at not more than 20 feet intervals.
- J. Anchor top rails to main posts with appropriate wrought or malleable fittings.
- K. Install bracing assemblies at all end and gate posts, as well as side, corner, and pull posts.
  - 1. Locate compression members at mid-height of fabric.
  - 2. Extend diagonal tension members from compression members to bases of posts.
  - 3. Install so that posts are plumb when under correct tension.
- L. Pull fabric taut and secure to posts and rails.
  - 1. Secure so that fabric remains in tension after pulling force is released.
  - 2. Secure to posts at not over 15 inches on-center, and to rails at not over 24 inches on-center, and to tension wire at not over 24 inches on-center.
  - 3. Use U-shaped wire conforming to diameter of pipe to which attached, clasp pipe and fabric firmly with ends twisted at least two full turns.

4. Bend ends of wire to minimize hazards to persons or clothing.
- M. Install post top at each post.
- N. Gates:
1. Construct with fittings or by welding.
  2. Provide rigid, weatherproof joints.
  3. Assure right, non-sagging, non-twisting gate.
  4. Coat welds with rust preventive paint, color to match pipe.
- O. Install electric gate operator in accordance with NFPA 70.

## **END OF SECTION**

**SECTION 32 91 13**  
**TOPSOILING AND FINISHED GRADING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Topsoiling and finished grading.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 31 23 00 - Earthwork.
  - 4. Section 31 25 00 - Soil Erosion and Sediment Control.
  - 5. Section 32 92 00 - Seeding.
- C. Location of Work: All vegetated areas which are disturbed in the course of the work.

**1.2 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Project Data: Test reports for furnished topsoil (if imported topsoil is used).

**1.3 PROJECT CONDITIONS**

- A. Verify amount of topsoil stockpiled and determine amount of additional topsoil, if necessary to complete work.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Topsoil:
  - 1. Original surface soil typical of the area.
  - 2. Existing topsoil stockpiled under Specification Section 31 23 00.
  - 3. Capable of supporting native plant growth.

**2.2 TOLERANCES**

- A. Finish Grading Tolerance: 0.1 FT plus/minus from required elevations.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Correct, adjust and/or repair rough graded areas.
  - 1. Cut off mounds and ridges.
  - 2. Fill gullies and depressions.
  - 3. Perform other necessary repairs.
  - 4. Bring all sub-grades to specified contours, even and properly compacted.
- B. Loosen surface to depth of 2 IN, minimum.
- C. Remove all stones and debris over 2 IN in any dimension.

### **3.2 PLACING TOPSOIL**

- A. Do not place when subgrade is wet or frozen enough to cause clodding.
- B. Spread to compacted depth of 4 IN for all disturbed earth areas.
- C. If topsoil stockpiled is less than amount required for work, furnish additional topsoil at no additional cost to OWNER.
- D. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension.
- E. Provide finished surface smooth and true to required grades.
- F. Restore stockpile area to condition of rest of finished work.

### **3.3 ACCEPTANCE**

- A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.

**END OF SECTION**

## **SECTION 32 92 00**

### **SEEDING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Seeding.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 1 - General Requirements.
  - 3. Section 32 91 13 - Topsoiling and Finished Grading.

##### **1.2 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Signed copies of vendor's statement for seed mixture required, stating botanical and common name, place of origin, strain, percentage of purity, percentage of germination, and amount of Pure Live Seed (PLS) per bag.
  - 3. Certification that each container of seed delivered will be labeled in accordance with Federal and State Seed Laws and equals or exceeds Specification requirements.

##### **1.3 SEQUENCING AND SCHEDULING**

- A. Installation Schedule:
  - 1. Provide schedule showing when seeding is anticipated.
  - 2. Indicate planting schedules in relation to schedule for finish grading and topsoiling.
  - 3. Indicate anticipated dates Engineer will be required to review installation for initial acceptance and final acceptance.
- B. Pre-installation Meeting:
  - 1. Meet with Owner and other parties as necessary to discuss schedule and methods, unless otherwise indicated by Owner.

#### **PART 2 - PRODUCTS**

##### **2.1 MATERIALS**

- A. Seed Quality:
  - 1. Fresh, clean, new-crop seed labeled in accordance with USDA Rules and Regulations under the Federal Seed Act in effect on date of bidding.
  - 2. Provide seed of species, proportions, and minimum percentages of purity, germination and maximum percentage of weed seed as specified.

B. Seed Mixture:

BOTANICAL AND COMMON NAME	PERCENT BY WEIGHT (PLS)	MINIMUM PERCENT PURITY
Tall Fescue, Falcon 31 (Festuca arundinacea)	65	90
Creeping Red Fescue (Festuca rubra)	25	90
Redtop (Agrostis alba)	10	90

C. Mulch:

1. For seeded areas:
  - a. Clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, peanuts, or other locally available mulch material which does not contain an excessive quantity of matured seeds of noxious weeds or other species that will grow or be detrimental to seeding, or provide a menace to surrounding land.
  - b. Do not use material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.

D. Fertilizer:

1. Commercial fertilizer meeting applicable requirements of State and Federal law.

E. Water:

1. Water free from substances harmful to grass or sod growth.
2. Provide water from source approved prior to use.

## PART 3 - EXECUTION

### 3.1 SOIL PREPARATION

A. General:

1. Limit preparation to areas which will be planted soon after.
2. Provide facilities to protect and safeguard all persons on or about premises.

B. Preparation for Seeding:

1. Loosen surface to minimum depth of 4 IN.
2. Remove stones over 1 IN in any dimension and sticks, roots, rubbish, and other extraneous matter.
3. Prior to applying fertilizer, loosen areas to be seeded with a double disc or other suitable device if the soil has become hard or compacted.
4. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.
5. Distribute fertilizer uniformly over areas to be seeded:
6. Incorporate fertilizer into soil to a depth of at least 2 IN by disking, harrowing, or other approved methods.
7. Remove stones or other substances from surface which will interfere with turf development or subsequent mowing operations.
8. Grade to a smooth, even surface with a loose, uniformly fine texture.
  - a. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
  - b. Limit fine grading to areas which can be planted soon after preparation.
9. Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and before planting.

### 3.2 INSTALLATION

A. Seeding:

1. Do not use seed which is wet, moldy, or otherwise damaged.
2. Perform seeding work from April 20 to May 15 for spring planting, and August 1 to September 15 for fall planting, unless otherwise approved by Owner.
3. Employ satisfactory methods of sowing using mechanical power-driven drills or seeders, or mechanical hand seeders, or other approved equipment.
4. Distribute seed evenly over entire area at rate of application not less than 4 LBS (PLS) of seed per 1000 SF.
5. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds excessive moisture, or other factors.
  - a. Resume work only when favorable conditions develop.
6. Lightly rake seed into soil followed by light rolling or cultipacking.
7. Immediately protect seeded areas against erosion by mulching.
  - a. Spread mulch in continuous blanket using 1-1/2 tons per acre to a depth of 4 or 5 straws.
8. Protect seeded slopes against erosion with erosion netting or other methods approved by Engineer.
  - a. Protect seeded areas against traffic or other use by erecting barricades and placing warning signs.
9. Immediately following spreading mulch, anchor mulch using a rolling coulter or a wheatland land packer having wheels with V-shaped edges to force mulch into soil surface.

### **3.3 MAINTENANCE AND REPLACEMENT**

#### **A. General:**

1. Begin maintenance of planted areas immediately after each portion is planted and continue until final acceptance or for a specific time period as stated below, whichever is the longer.
2. Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep planted areas uniformly moist as required for proper growth.
3. Protection of new materials:
  - a. Provide barricades, coverings or other types of protection necessary to prevent damage to existing improvements indicated to remain.
  - b. Repair and pay for all damaged items.
4. Replace unacceptable materials with materials and methods identical to the original specifications unless otherwise approved by the Engineer.

#### **B. Seeded Areas:**

1. Maintain seeded areas: 90 days, minimum, after installation and review of entire project area to be planted.
2. Maintenance period begins at completion of planting or installation of entire area to be seeded or sodded.
3. Owner will review seeded area after installation for initial acceptance.
4. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose.
  - a. Anchor as required to prevent displacement.
5. Unacceptable plantings are those areas that do not meet the quality of the specified material, produce the specified results, or were not installed to the specified methods.
6. Replant bare areas using same materials specified.
7. Owner will review final acceptability of installed areas at end of maintenance period.
8. Maintain repaired areas until remainder of maintenance period or approved by Owner, whichever is the longer period.

### **END OF SECTION**

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DIVISION 33

UTILITIES



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**SECTION 33 05 16**  
**PRECAST CONCRETE MANHOLE STRUCTURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Precast concrete manhole structures and appurtenant items.
    - a. Sanitary sewer manholes and appurtenances.
    - b. Drain manholes and appurtenances.
    - c. Storm sewer manholes and appurtenances.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
  - 4. Section 03 21 00 - Reinforcement.
  - 5. Section 03 31 30 - Concrete Materials and Proportioning.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A48/A48M, Standard Specification for Gray Iron Castings.
    - b. C150/C150M, Standard Specification for Portland Cement.
    - c. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
    - d. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
    - e. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
    - f. D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  - 3. Fabrication and/or layout drawings:
    - a. Include detailed diagrams of manholes showing typical components and dimensions, reinforcements and other details.
    - b. Itemize, on separate schedule, sectional breakdown of each manhole structure with all components and refer to drawing identification number or notation.
    - c. Indicate knockout elevations for all piping entering each manhole.
- B. Unless approved prior to submittal, submit all products from this Specification Section in one complete submittal package. Include all products and accessories together.

**1.4 SITE CONDITIONS**

- A. For this project, the established high groundwater elevation is 309 FT MSL (Mean Sea Level).

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Manhole rings, access hatches, covers and frames:
    - a. Neenah Foundry and Neenah Enterprises, Inc.
    - b. Deeter Foundry.
    - c. Halliday.
    - d. USFfab.
  - 2. Black mastic joint compound:
    - a. Kalktite 340.
    - b. Tufflex.
    - c. Plastico.
  - 3. Premolded joint compound:
    - a. RAM-NEK.
    - b. Kent Seal.
  - 4. Emulsified fibrated asphalt compound:
    - a. Sonneborn Hydrocide 700B.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

### **2.2 SANITARY SEWER, STORM AND DRAIN MANHOLE STRUCTURE COMPONENTS**

- A. Manhole Components:
  - 1. Reinforcement: ASTM C478.
  - 2. Minimum wall thickness: 5 IN.
  - 3. Minimum base thickness: 12 IN.
  - 4. Provide the following components for each manhole structure:
    - a. Base (precast) with integral bottom section or (cast-in-place).
    - b. Precast bottom section(s).
    - c. Precast barrel section(s).
    - d. Precast eccentric transition section.
    - e. Precast adjuster ring(s).
    - f. Precast concrete transition section.
    - g. Precast flat top.
  - 5. Unless dimensioned or specifically noted on Drawings, provide manhole section with minimum 48 IN inside dimensions.
- B. Non-Pressure Type Frames and Cover:
  - 1. Cast iron frame and covers: ASTM A48/A48M, Class 35 (minimum).
  - 2. Use only cast iron of best quality, free from imperfections and blow holes.
  - 3. Furnish frame and cover of heavy-duty construction a minimum total weight of 450 LBS.
  - 4. Machine all horizontal surfaces.
  - 5. Furnish unit with solid non-ventilated lid with concealed pick-holes.
    - a. Letter covers "SEWER" for all collection system manholes, "DRAIN" for all gravity unit drains returning flow to the headworks, and "STORM" for storm sewer systems.
  - 6. Ensure minimum clear opening of 24 IN DIA.
- C. Pressure Type Frame and Cover:
  - 1. Provide covers meeting the requirements of the Non-pressure Type Frames and Cover paragraph above and as modified below.
  - 2. Furnish frame and bolted cover of heavy-duty construction.
    - a. Equip unit with six (6) stainless steel countersunk 3/8 IN DIA by 1-1/2 IN long bolts with stainless steel washers.
  - 3. Provide solid lid and minimum 1/8 IN thick x 1/2 IN wide continuous strip neoprene gasket.

4. Furnish unit with a minimum of six (6) anchorage holes and six (6) 6 IN long x 3/4 IN DIA stainless steel anchor bolts.
- D. Special Coatings and Joint Treatment:
  1. Joints of precast sections:
    - a. Black mastic compound: ASTM D4586.
  2. Vertical wall surfaces:
    - a. Emulsified fibrated asphalt compound meeting ASTM D1227 Type II for all exterior vertical wall surfaces.
- E. Sanitary Sewer Manhole Concrete:
  1. Provide all sanitary manholes constructed with Portland ASTM C150/C150M, Type I or II cement with a tricalcium aluminate content not to exceed 8 percent.
  2. Mix aggregate shall be a minimum of 50 percent crushed limestone.
  3. Provide 3000 psi non-shrink grout.
- F. Access Hatches
  1. See Process Drawings

## **PART 3 - EXECUTION**

### **3.1 MANHOLE CONSTRUCTION**

- A. General:
  1. Construct cast-in-place concrete base slabs.
  2. Make inverts with a semi-circular bottom conforming to the inside contour of the adjacent sewer sections.
  3. On all straight runs, lay pipe through manhole and cut out top half of pipe.
    - a. See detail on Drawings.
    - b. If pipes deflect at manhole, shape as specified in Paragraphs 2 and 4 in this General Paragraph.
  4. Shape inverts accurately and steel trowel finish.
    - a. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert using as large a radius as manhole inside diameter will permit.
    - b. Pour base slab integral with bottom barrel section.
- B. Build each manhole to dimensions shown on plans and at such elevation that pipe sections built into wall of manhole will be true extensions of line of pipe.
- C. For all horizontal mating surfaces between concrete and concrete or concrete and metal, above established high groundwater elevation shown trowel apply to clean surface black mastic joint compound to a minimum wet thickness of 1/4 IN immediately prior to mating the surfaces.
- D. For horizontal joints that fall below established high groundwater elevation shown, install a resilient O-ring type gasket or pre-molded joint compound.
- E. Seal all pipe penetrations in manhole.
  1. Form pipe openings smooth and well-shaped.
  2. After installation, seal cracks with, non-shrink grout.
  3. After grout cures, wire brush smooth and apply two coats emulsified fibrated asphalt compound to minimum wet thickness of 1/8 IN to ensure complete seal.
- F. Set and adjust frame and cover final 6 IN (minimum) to 18 IN (maximum) to match finished pavement or finished grade elevation using precast adjuster rings.

## **END OF SECTION**

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**SECTION 33 05 23**  
**PIPELINE UNDERCROSSINGS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Construction of pipe undercrossings.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.

**1.2 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Compliance with submittal requirements of authority or agency having jurisdiction over undercrossing.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Casing Pipe:
  - 1. Structural grade steel: Minimum yield strength of 35,000 psi or greater as required by the permits.
  - 2. Wall thickness: Minimum 0.250 IN or greater as required by the permits.
  - 3. Diameter: Minimum of 4 IN larger than outside diameter of carrier pipe's jointing system.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. General:
  - 1. Install undercrossing to meet requirements of authority or agency having jurisdiction over undercrossing.
  - 2. Observe work requirements stipulated in any permit condition.
  - 3. Consult Contract Drawings for limitation of construction right-of-way.
- B. If installation of crossing is by jacking or dry boring, the following will be required unless more rigid requirements are specified by the authority or agency having jurisdiction over the crossing:
  - 1. Diameter of the hole: Not exceeding diameter of casing by more than 1-1/2 IN.

2. Pressure grout all voids outside of casing, including abandoned or misaligned holes.
3. Fill void between carrier pipe and casing wall with blow sand.
  - a. Install watertight grouted plug minimum of 1 FT deep at both ends.
4. Undercrossing casing:
  - a. Full lengths.
  - b. Weld pressure tight.
5. After casing is installed, band wood blocks 120 degrees apart to each length of carrier pipe to prevent displacement and pull pipe into place.
  - a. Pipe must be straight and centered in casing when in place.
6. Coordinate connections to system with authority or agency having jurisdiction over the crossing.

## **END OF SECTION**



## **SECTION 33 11 15**

### **WATER WELLS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

**A. Section Includes:**

1. Construction and development of a domestic well of a capacity of not less than 5 gpm capacity, at least 320 ft deep, with casing large enough to pass a 5 gpm pump and 3/4 hp submersible 230 volt single phase motor and have interstitial space for adequate cooling flow per the recommendation of the motor manufacturer.
2. Provision of submersible pump, motor, power and control cables, drop pipe and pitless adapter and well cap.
3. Test pumping of the well including well recovery measurements.
4. Well analysis and report.
5. Disinfection of the water supply well.
6. Obtain any required permits.

##### **1.2 QUALITY ASSURANCE**

**A. Referenced Standards:**

1. ASTM International (ASTM):
  - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - b. C150, Standard Specification for Portland Cement.
  - c. C494, Standard Specification for Chemical Admixtures for Concrete.
2. American Petroleum Institute (API):
  - a. 5L, Specification for Line Pipe
3. American Welding Society (AWS):
  - a. Code for Arc and Gas Welding.
4. American Water Works Association (AWWA):
  - a. A100, Standard for Water Wells.
5. NSF International (NSF):
  - a. 61, Drinking Water System Components – Health Effects.

**B. Qualifications:**

1. Have completed at least 10 successful sand free water supply wells with minimum depth and diameter of 320 feet and 5 inches, respectively, within the last five years.
2. Submit list of above wells with bid.
  - a. Include location, Owner, and brief description of wells.
  - b. Provide Owner contact name, telephone number, and email address for each referenced well.
3. Submit identification and qualification of person(s) analyzing driller's log, whether on driller's staff, special consultant, or equipment manufacturer.

**C. Comply with all State of Maine rules and regulations concerning domestic supply wells.**

##### **1.3 SUBMITTALS**

**A. Shop Drawings:**

1. Product technical data including:
  - a. Well drawing.
  - b. Submittal of:
    - 1) Well casing
    - 2) Drop pipe
    - 3) Pitless Adapter and well cap

- 4) Well pump and motor
- B. Contract Closeout Information:
  1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Submit the following well data at appropriate times during construction.
  1. Daily driller's report:
    - a. During the drilling of the well, maintain a daily, detailed driller's report.
    - b. Furnish a complete description of all formations encountered, number of feet drilled, number of HRS on the job, shutdown due to breakdown, quantity of material installed, and other pertinent data as may be requested by the Engineer.
    - c. Values of tested drilling fluid properties.
  2. Driller's log:
    - a. During the drilling of the well, prepare and keep and complete log setting forth the following:
      - 1) The reference point for all depth measurements.
      - 2) The depth at which each change of formation occurs.
      - 3) The depth at which the first water was encountered.
      - 4) The thickness of each stratum.
      - 5) The identification of the material of which each stratum is composed, such as:
        - a) Clay.
        - b) Sand or silt.
        - c) Sand and gravel: Indicate whether gravel is loose, tight, angular or smooth; color.
        - d) Cementation: Indicate whether grains (if present) have natural cementing materials between them, e.g., silica, calcite, etc.
        - e) Rock hardness.
      - 6) Samples of formations encountered (one set total).
      - 7) The depth interval from which each formation sample was taken.
      - 8) Sieve analysis of each significant water bearing formation.
      - 9) The depth to the static water level (SWL) and changes in SWL with well depth if measurable with drilling method used.
      - 10) Total depth of pilot borehole.
      - 11) Recommended gravel pack gradation and well screen type and opening size with calculations to support recommendations.
        - a) Submit name of gravel pack supplier.
      - 12) Any and all other pertinent information for a complete and accurate log.
      - 13) Depth or location of any lost drilling fluid, drilling materials or tools.
      - 14) The depth of the surface seal.
      - 15) The amount and type of cement (number of sacks) installed for the seal.
      - 16) The depth and description of the well casing.
      - 17) The description (to include type, length, diameter, slot sizes, material, and manufacturer) and location of well screens.
        - a) Include full manufacturer's recommendations for screen to casing attachment with specific connection or welding recommendations.
      - 18) Results of well alignment and plumbness test.
      - 19) The sealing off of water-bearing strata, if any, and the exact location thereof.
    3. Well performance and recommendations:
      - a. Provide description of methods and results of development of well.
      - b. Include in this report recommendations for size and depth setting of pump, and allowable daily pumping.
    4. Drawings showing "As Constructed" conditions for completed well.
    5. Completed State of Maine Well Registration Form.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Pumps and motors:
  - a. Goulds
  - b. Franklin

### **2.2 MATERIALS**

A. Well Casing:

1. With the exception of the conductor casing, all casing material shall be new and unused.
2. Plain ends of each joint shall be machine beveled perpendicular to the casing to ensure the straightness of each assembled section.
3. Provide 80' of steel or PVC well Casing
4. Painting required if casing is steel:
  - a. Paint the exterior of the casing above existing ground using one of the following manufacturers' systems:

TNEMEC	COOK	KOPPERS
Primer coat 46-413	920 B221	300 M
min 8 dry MILS	min 8 dry MILS	min 8 dry MILS
Finish coat 46-413	920 B221	300 M
min 8 dry MILS	min 8 dry MILS	min 8 dry MILS

B. Well Casing and Screen Centralizers:

1. Materials shall be physically and chemically compatible with the well casing or screen.
2. Centralizers shall be fitted on all casing using Halliburton or approved equal centralizers with "bow-string" straps.
3. Centralizers shall meet the requirements of API Specification 10D.
4. Centralizers shall be designed to provide adequate centering of well casing or screen of the diameter and to the depths required for this project.

### **2.3 CEMENT MIXES**

A. Well Grout:

1. Concrete grout to be a mixture of cement, sand, and water in the proportion of 94 pounds of Portland cement (ASTM C150 or API Class A) and an equal volume of dry sand to not more than 6 GAL of potable quality water.
  - a. Where large volumes are required to fill annular openings, gravel not larger than 1/2 inches in size may be added in lieu of sand.
  - b. Do not use concrete grout below the water level in the well.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

A. Well Drilling Method:

1. Drill boreholes suitable for construction of a water supply well.
2. Drilling fluid:
  - a. Take all necessary measures to protect water bearing formations from contamination and ensure that the drilling method used will not permanently plug the water bearing formations with drilling fluid.

- b. The Contractor may utilize a drilling fluid comprised of either a polymer-based “mud” or a bentonite “gel”-based mud. Use of a bentonite viscosifier only, meeting the requirements of API Standard 13A, will not be permitted.
  - c. All drilling fluid components and additives shall be NSF-61 approved.
  - d. The use of salt or brine as a method of increasing the mud weight during drilling will not be permitted during the construction of the well. Any materials proposed for controlling artesian flow must be reviewed and approved by the Engineer prior to use.
  - e. Provide and operate portable laboratory equipment for monitoring basic drilling fluid properties to include density, viscosity, pH, and filtrate rate.
  - f. Use clean water, free of organic material, for drilling fluid unless otherwise approved by Engineer.
3. Sanitary protection of well:
- a. At all times during the progress of the work, use reasonable precautions to prevent either tampering with the well or the entrance of foreign material into it.
    - 1) Keep well drilling equipment and tools clean.
    - 2) Cap conductor casing with a watertight welded or threaded cap or equipped with some other type of "vandal proof" cover when Contractor is off site.
  - b. Upon completion of well, install a suitable threaded, flanged, or welded cap or compression seal satisfying applicable state or local regulations or recommendations.
  - c. Extend watertight casing of well to not less than 12 inches above the pumphouse floor or final ground level elevation, or to level shown on Drawings.
  - d. Seal or screen any equipment which will permit direct access to the well.
    - 1) Meet the above height requirements to prevent entrance of foreign matter or contaminants.
  - e. Slope ground immediately surrounding the top of the well casing away from well.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Well Casing:
  - 1. Provide casing joints which are threaded and coupled watertight joints or welded conforming to the standards of the AWS.
  - 2. The well casing assembly shall be suspended by the drilling rig and not permitted to rest on the bottom of the borehole.
- C. Centralizers:
  - 1. Extend out a minimum of 2 inches from casing or screen.
  - 2. Place at 60 feet intervals starting 5 feet from the bottom of the string and extending to ground surface.
  - 3. Place at least four equally spaced at each interval in such a manner that interference with gravel pack placement is minimized.
  - 4. Fit on steel casing with straps at 0 degrees, 90 degrees, 180 degrees, and 270 degrees around casing at each position.
- D. Well Grout:
  - 1. Grout annular space between well casing and drill hole to seal well against infiltration of contaminated water.
  - 2. Ensure that annular space is free from obstructions before placing grout.
  - 3. Place grout uniformly into annular space.
    - a. Use Positive Displacement Method (Interior or Exterior) in accordance with AWWA A100, Appendix C. Placement through a float shoe is also acceptable.
    - b. Ensure that no voids are formed in grout seal.
    - c. Place grout in a continuous operation to land surface.
  - 4. Install grout in well from top of gravel pack to ground surface.
  - 5. If directed, pressure test grout seal in presence of the Owner.
    - a. No work in the well will be permitted for 72 hours after grouting.

- b. Ensure that all grout is placed before occurrence of the initial set.
- E. Protection of Quality of Water:
  - 1. Take necessary precautions to prevent contamination of the well and the aquifer from which the well is to draw its supply.
  - 2. In the event the well becomes contaminated due to the neglect of the Contractor, the Contractor, at his own expense, will perform such work as may be necessary to eliminate the contamination.

### **3.3 FIELD QUALITY CONTROL**

- A. Well Development:
  - 1. Furnish necessary pumps, compressors, plungers, bailers, or other needed equipment and develop well by such approved methods as necessary to give the maximum yield of water per foot of drawdown and limit sand content as indicated herein.
- B. Well Performance Tests:
  - 1. Pumping test method:
    - a. Furnish, install and remove, when complete, the necessary measuring instruments and pumping equipment capable of pumping to the required point of discharge a minimum 7.5 GPM, and with satisfactory throttling devices, so that the discharge may be reduced to 5 GPM.
    - b. Furnish pumping unit complete with an ample power source, controls and appurtenances capable of being operated without interruption.
    - c. Failure of pump operation for a period greater than 1% of the elapsed pumping time shall require suspension of the test until the water level in the pumped well has recovered to its original level.
      - 1) Recovery is considered "complete" after the well has been allowed to rest for a period at least equal to the elapsed pumping time of the aborted test except that if any three successive water level measurements spaced at least 20 minutes apart show no further rise in the water level in the pumped well, the test may be resumed immediately.
      - a) The Engineer or Owner's Representative shall be the sole judge as to whether this latter condition exists.
    - d. After completing the final test, remove by bailing, sand pumping or other methods, any sediment, stones or other foreign material that may have accumulated in the well.
      - 1) Time stated for the duration of the final test is a minimum only and the Engineer reserves the right to request the Contractor to extend such period of test, or to make additional tests.
  - 2. Sand content testing:
    - a. The sand content shall be determined by averaging the results of five samples collected at the following times during the final pumping test:
      - 1) 15 minutes after start of the test.
      - 2) After 1/4 of the total planned test time has elapsed.
      - 3) After 1/2 of the total planned test time has elapsed.
      - 4) After 3/4 of the total planned test time has elapsed.
      - 5) Near the end of the pumping test.
    - b. Sand production during well development and testing shall be measured by the Contractor and recorded on test records. Sand production shall be quantified as measured by a Rossum™ Sand Sampler. Sand production shall not exceed 5 PPM at the end of the constant-discharge pumping test as per AWWA Standard A100.
    - c. Maximum allowable sand content in well discharge is 5 mg/L
- C. Well Disinfection:
  - 1. After well is completed, disinfect well and pump with chlorine solution.
    - a. Thoroughly clean well of all foreign substances, oil, grease, joint dope, and scum, including tools, timbers, rope, debris, cement, prior to disinfection.

- b. Utilize chemical cleaners if necessary.
  2. Disinfect well in accordance with the State of Maine.
  3. Furnish chlorine solution for disinfecting the well of such volume and strength that a minimum residual concentration of 50 PPM of chlorine is obtained in all parts of the well for a minimum contact period of 2 hours.
- D. Water Quality Analysis:
1. Before disinfecting the well, obtain water samples for chemical analysis and submit to the State of Maine for testing.
  2. After disinfecting and flushing well, obtain a water sample for bacterial testing and submit to the State of Maine for testing.
  3. If samples do not meet Department of Maine requirements, or coliform organisms are present, again disinfect well until an acceptable test report is obtained.

**END OF SECTION**

**SECTION 33 46 00**  
**FOUNDATION AND UNDER-POND DRAINAGE SYSTEM**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish labor, materials, tools, equipment, and services for Foundation and Under-Pond Drainage System, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

**1.2 DESCRIPTION**

- A. Definitions:
  - 1. Foundation drainage system: A system of drains outside foundation walls which drains by gravity, connects to and drains into sewer system or storm drain system.
  - 2. Under-Pond drainage system: A system of sub-drains under rearing ponds, which drains by gravity, connecting to pond outlet structures.

**1.3 QUALITY ASSURANCE**

- A. ASTM International (ASTM):
  - 1. ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - 2. ASTM D2412 Standard Method for Determination of Loading Characteristics of Plastic Pipe by Parallel Plate Loading.
  - 3. ASTM-D2729 Standard specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - 4. ASTM D2661 Standard specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
  - 5. ASTM D4833 Standard Test Method for Index Resistance of Geotextiles, Geomembranes, and Related Products.
  - 6. ASTM D4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile.
  - 7. ASTM D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
  - 8. ASTM F949 Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

**1.4 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer of listed products.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Drain lines, with minimum crushing strength of 1800 kg/m 1200 LB/FT:
  - 1. One of following:
    - a. ASTM D2729, PVC Perforated Sewer Pipe and Fittings.
  - 2. Performance Standards:
    - a. ASTM D4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
    - b. ASTM D4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile.

3. Inside pipe diameter: Minimum 150 MM 6 IN, unless noted otherwise.
  4. Fittings of corresponding weight and quality.
  5. Use one-eighth bends for change in direction.
  6. Use Y-fittings at intersections.
  7. Joint couplings:
    - a. Sleeve type or tapered, to hold firmly in alignment without sealants or gaskets.
- B. Filter Material:
1. Gravel and sand graded as follows:
    - a. 95 to 100 PCT passing 25 MM 1 IN sieve.
    - b. 20 to 85 PCT passing 10 MM 3/8 IN sieve.
    - c. 0 to 10 PCT passing No.10 sieve.
    - d. 0 to 3 PCT passing No.200 sieve.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Lay minimum 1830 MM 6 FT wide strip of fabric on subgrade.
- B. Place minimum of 150 MM 6 IN of filter material below drains.
- C. Lay under-pond drains as indicated on drawings.
  1. Cut out channel into subgrade, if necessary.
- D. Lay foundation drains with centerline of drain nominally 150 MM 6 IN from footing or foundation wall.
- E. Lay drain lines firmly bedded in filter material to true grades and alignment.
  1. Face bells upgrade.
  2. Provide continuous fall in direction of flow.
  3. Lay pipe with perforations down, with closed joints.
- F. Test drain lines with water to assure free flow before covering.
  1. Remove obstructions and re-test until satisfactory.
- G. Backfill over under-pond drains with filter material as indicated on drawings.
- H. Backfill over foundation drains with filter material to 150 MM 6 IN below finish grade, minimum 610 MM 24 IN wide from foundation wall.
- I. Compact filter material to density required to preclude settlement, with vibrator/tamper.
- J. Take care to avoid damage to foundation.

### **END OF SECTION**





## DIVISION 40

### PROCESS INTERCONNECTIONS



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**SECTION 40 05 00**  
**PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Cleanouts
  - 2. Process piping systems.
  - 3. Utility piping systems.
  - 4. Plumbing piping systems.
- B. Cleanout for 8" pipe:
  - 1. Acceptable manufacturers
    - a. Zurn                      Z1474-DC
    - b. Or Equal
  - 2. Design Requirements
    - a. Heavy iron ferrule at least 9" long
    - b. Anchor Flange or flashing flange 2-3/4 to 5" from top
    - c. Heavy duty iron top design without screws
    - d. Maximum body inside diameter 8-3/8"
- C. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 01 61 03 - Equipment: Basic Requirements.
  - 4. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities
  - 5. Section 40 05 07 - Pipe Support Systems.
  - 6. Section 40 05 51 - Valves: Basic Requirements.
  - 7. Section 40 42 00 - Pipe, Duct and Equipment Insulation.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Association of State Highway and Transportation Officials (AASHTO):
    - a. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
    - b. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.
  - 2. American Iron and Steel Institute (AISI).
  - 3. American Society of Mechanical Engineers (ASME):
    - a. B16.3, Malleable Iron Threaded Fittings.
    - b. B16.5, Pipe Flanges and Flanged Fittings.
    - c. B36.19, Stainless Steel Pipe.
    - d. B40.100, Pressure Gauges and Gauge Attachments.
  - 4. ASTM International (ASTM):
    - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
    - c. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - d. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
    - e. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
    - f. A536, Standard Specification for Ductile Iron Castings.

- g. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
  - h. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
  - i. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
  - j. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
  - k. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
  - l. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
  - m. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  - n. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  - o. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- 5. American Water Works Association/American National Standards Institute (AWWA/ANSI):
    - a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
    - b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    - c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
    - d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
  - 6. Cast Iron Soil Pipe Institute (CISPI):
    - a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
  - 7. International Plumbing Code (IPC).
  - 8. National Fire Protection Association (NFPA):
    - a. 54, National Fuel Gas Code.
    - b. 69, Standard on Explosion Prevention Systems.
  - 9. Underwriters Laboratories, Inc. (UL).
- B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

### **1.3 SYSTEM DESCRIPTION**

- A. Piping Systems Organization and Definition:
  - 1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
  - 2. See PIPING SPECIFICATION SCHEDULES in PART 3.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
    - c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
      - 1) Attach technical product data on gaskets, pipe, fittings, and other components.
  - 3. Fabrication and/or layout drawings:

- a. Exterior yard piping drawings (minimum scale 1 IN equals 10 FT) with information including:
    - 1) Dimensions of piping lengths.
    - 2) Invert or centerline elevations of piping crossings.
    - 3) Acknowledgement of bury depth requirements.
    - 4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
    - 5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
    - 6) Line slopes and vents.
  - b. Interior piping drawings (minimum scale 1/8 IN equals 1 FT) with information including:
    - 1) Dimensions of piping from column lines or wall surfaces.
    - 2) Invert dimensions of piping.
    - 3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
    - 4) Location and type of pipe supports and anchors.
    - 5) Locations of valves and valve actuator type.
    - 6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
    - 7) Acknowledgement of valve, equipment and instrument tag numbers.
    - 8) Provisions for expansion and contraction.
    - 9) Line slopes and air release vents.
    - 10) Rough-in data for plumbing fixtures.
  - c. Schedule of interconnections to existing piping and method of connection.
- B. Operation and Maintenance Manuals:
- 1. See Specification 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.
- C. Informational Submittals:
- 1. Qualifications of lab performing disinfection analysis on water systems.
  - 2. Test reports:
    - a. Copies of pressure test results on all piping systems.
    - b. Reports defining results of dielectric testing and corrective action taken.
    - c. Disinfection test report.
    - d. Notification of time and date of piping pressure tests.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect pipe coating during handling using methods recommended by manufacturer.
  - 1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.
- B. Prevent damage to pipe during transit.
  - 1. Repair abrasions, scars, and blemishes.
  - 2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Insulating unions:
    - a. "Dielectric" by Epco.
  - 2. Dielectric flange kit:

- a. PSI.
  - b. Maloney.
  - c. Central Plastics.
- 3. Pipe saddles (for gage installation):
  - a. Dresser Style 91 (steel and ductile iron systems).
  - b. Dresser Style 194 (nonmetallic systems).
- 4. Expansion joints:
  - a. PROCO.
  - b. Mercer
- 5. Flanged adaptors:
  - a. Ford.
  - b. Romac.
  - c. Clow
- 6. Compression sleeve couplings:
  - a. Romac.
  - b. Ford.
  - c. JCM.
- 7. Insulating couplings:
  - a. Romac.
  - b. Smith-Blair Stle 416
  - c. Dresser Style 39.
- 8. Transition coupling:
  - a. Ford
  - b. Romac
  - c. JCM
- 9. Restrained glands
  - a. Sigma
  - b. Ford
  - c. Star
- 10. Restrained joints:
  - a. American (Lock Fast) - 12 IN and below.
  - b. U.S. Pipe (TR-Flex) - 4 IN to 54 IN.
  - c. American (Lock Fast) - Above 12 IN.

B. Submit request for substitution in accordance with Specification Section 01 33 00.

## **2.2 PIPING SPECIFICATION SCHEDULES**

A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping specification schedules located at the end of PART 3 of this Specification Section.

## **2.3 COMPONENTS AND ACCESSORIES**

A. Insulating Components:

- 1. Dielectric flange kits:
  - a. Flat faced.
  - b. 1/8 IN thick dielectric gasket, phenolic, non-asbestos.
  - c. Suitable for 175 psi, 210 DegF.
  - d. 1/32 IN wall thickness bolt sleeves.
  - e. 1/8 IN thick phenolic insulating washers.
- 2. Dielectric unions:
  - a. Screwed end connections.
  - b. Rated at 175 psi, 210 DegF.
  - c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.

B. Reducers:

1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections.
  2. Connection size requirements may change from those shown on Drawings depending on equipment furnished.
- C. Protective Coating and Lining:
1. Include pipe, fittings, and appurtenances where coatings, linings, paint, tests and other items are specified.
  2. Field paint pipe in accordance with Specification Section 09 96 00.
- D. Valves:
1. See Drawings for valves used in each system.
  2. See Specification Section 40 05 51.
- E. Expansion Joints:
1. Materials:
    - a. Body: Reinforced EPDM.
    - b. Flange rings: galvanized.
    - c. Limit bolts and nuts: galvanized.
  2. Pressure rating at 70 DegF: 75 psig or better.

## **PART 3 - EXECUTION**

### **3.1 EXTERIOR BURIED PIPING INSTALLATION**

- A. Unless otherwise shown on the Drawings, provide a minimum of 3 FT earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing except where specifically indicated otherwise in the Drawings.
- B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals specified in Specification Section 01 73 20 and as shown on Drawings.
- C. When entering or leaving structures with buried mechanical joint piping, install joint within 2 FT of point where pipe enters or leaves structure.
1. Install second joint not more than 6 FT nor less than 4 FT from first joint.
- D. Install expansion devices as necessary to allow expansion and contraction movement.
- E. Laying Pipe In Trench:
1. Excavate and backfill trench in accordance with Specification Section 31 23 33.
  2. Clean each pipe length thoroughly and inspect for compliance to specifications.
  3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
  4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
  5. Except for first two (2) joints, before making final connections of joints, install two (2) full sections of pipe with earth tamped alongside of pipe or final with bedding material placed.
  6. Lay pipe in only suitable weather with good trench conditions.
    - a. Never lay pipe in water except where approved by Engineer.
  7. Seal open end of line with watertight plug if pipe laying stopped.
  8. Remove water in trench before removal of plug.
- F. Lining Up Push-On Joint Piping:
1. Lay piping on route lines shown on Drawings.
  2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
  3. Observe maximum deflection values stated in manufacturer's written literature.
  4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
  5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

- G. Anchorage and Blocking:
  - 1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
  - 2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
    - a. Concrete blocks shall not cover pipe joints.
  - 3. Provide bearing area of concrete in accordance with drawing detail.
- H. Install underground hazard warning tape.
- I. Install insulating components where dissimilar metals are joined together.

### **3.2 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION**

- A. Install piping in vertical and horizontal alignment as shown on Drawings.
- B. Alignment of piping smaller than 4 IN may not be shown; however, install according to Drawing intent and with clearance and allowance for:
  - 1. Expansion and contraction.
  - 2. Operation and access to equipment, doors, windows, hoists, moving equipment.
  - 3. Headroom and walking space for working areas and aisles.
  - 4. System drainage and air removal.
- C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Specification Section 01 73 20 and as shown on the Drawings.
- D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.
- E. Pipe Support:
  - 1. Use methods of piping support as shown on Drawings and as required in Specification Section 40 05 07.
  - 2. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.
    - a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
  - 3. Size pipe supports with consideration to specific gravity of liquid being piped.
- F. Locate and size sleeves and castings required for piping system.
  - 1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.
- G. Use reducing fittings throughout piping systems.
  - 1. Bushings will not be allowed unless specifically approved.
- H. Equipment Drainage and Miscellaneous Piping:
  - 1. Provide drip pans and piping at equipment where condensation may occur.
  - 2. Hard pipe stuffing box leakage to nearest floor drain.
  - 3. Avoid piping over electrical components such as motor control centers, panelboards, etc.
    - a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.
    - b. Hard pipe drainage to nearest floor drain.
  - 4. Collect system condensate at drip pockets, traps and blowoff valves.
  - 5. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.
  - 6. For applications defined above and for other miscellaneous piping which is not addressed by a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.
    - a. Size to handle application with 3/4 IN being minimum size provided.
- I. Unions:
  - 1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.



2. Mechanical type couplings may serve as unions.
  3. Additional flange unions are not required at flanged connections.
- J. Install expansion devices as necessary to allow expansion/contraction movement.
- K. Provide full face gaskets on all systems.
- L. Anchorage and Blocking:
1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.
- M. Equipment Pipe Connections:
1. Equipment - General:
    - a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
    - b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
    - c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint.
      - 1) Provide tightening torque in accordance with manufacturer's recommendations.
    - d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
    - e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
    - f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
    - g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
    - h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four (4) bolts per joint installed and tightened.
      - 1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
      - 2) Realign as necessary, install flange bolts and make equipment connection.
    - i. Provide utility connections to equipment shown on Drawings, scheduled or specified.
  2. Plumbing and HVAC equipment:
    - a. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers, pressure reducing valves, flow control valves and relief valves provided with or as integral part of equipment.
    - b. Furnish and install sinks, fittings, strainers, pressure reducing valves, flow control valves, pressure relief valves, and shock absorbers which are not specified to be provided with or as integral part of equipment.
    - c. For each water supply piping connection to equipment, furnish and install union and gate or angle valve.
      - 1) Provide wheel handle stop valve at each laboratory sink water supply.
      - 2) Minimum size: 1/2 IN.
    - d. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system.
      - 1) Size trap as required by IPC.
    - e. Stub piping for equipment, sinks, lavatories, supply and drain fittings, key stops, "P" traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and protect until such time when later installation is performed.
- N. Provide insulating components where dissimilar metals are joined together.
- O. Instrument Connections:
1. See drawing details.

### **3.3 CONNECTIONS WITH EXISTING PIPING**

- A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.
- B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.
- C. Undertake connections in fashion which will disturb system as little as possible.
- D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.
- E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.
- F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.
- G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

### **3.4 ACCESS PROVISIONS**

- A. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, piping and piping appurtenances requiring service.
- B. Size of access panels to allow inspection and removal of items served, minimum 10 x 14 IN size.
- C. Fabricate door and frame of minimum 14 GA, stretcher leveled stock, cadmium plated or galvanized after fabrication and fitted with screw driver lock of cam type.
- D. Provide with key locks, keyed alike, in public use areas.
- E. Furnish panels with prime coat of paint.
- F. Style and type as required for material in which door installed.
- G. Where door is installed in fire-rated construction, provide door bearing UL label required for condition.

### **3.5 CATHODIC PROTECTION**

- A. Isolate, dielectrically, all piping from all other metals including reinforcing bars in concrete slabs, other pipe lines, and miscellaneous metal.
- B. Make all connections from wire or cable by Thermit Cadwelding accomplished by operators experienced in this process.
- C. Install all cables with a loop and overhead knot around each pipe and slack equal to at least 50 percent of the straight line length.
- D. After cadwelding, coat all exposed metallic surfaces with hot applied tape.

### **3.6 FIELD QUALITY CONTROL**

- A. See Piping Legend and Material Schedule in the Drawings for pipe testing criteria
  - 1. Hydrostatic pressure testing methodology:
    - a. General:
      - 1) All joints, including welds, are to be left exposed for examination during the test.
      - 2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
      - 3) Provide temporary restraints for expansion joints for additional pressure load under test.

- 4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
- 5) Do not paint or insulate exposed piping until successful performance of pressure test.
- b. Soil, waste, drain and vent systems:
  - 1) Test at completion of installation of each stack or section of piping by filling system with water and checking joints and fittings for leaks.
  - 2) Eliminate leaks before proceeding with work or concealing piping.
  - 3) Minimum test heights shall be 10 FT above highest stack inlet.
2. Air testing methodology:
  - a. General:
    - 1) Assure air is ambient temperature.
  - b. Low pressure air testing:
    - 1) Place plugs in line and inflate to 25 psig.
    - 2) Check pneumatic plugs for proper sealing.
    - 3) Introduce low pressure air into sealed line segment until air pressure reaches 4 psig greater than ground water that may be over the pipe.
      - a) Use test gage conforming to ASME B40.100 with 0 to 15 psi scale and accuracy of 1 percent of full range.
    - 4) Allow 2 minutes for air pressure to stabilize.
    - 5) After stabilization period (3.5 psig minimum pressure in pipe) discontinue air supply to line segment.
    - 6) Record pressure at beginning and end of test.
- B. Dielectric Testing Methods and Criteria:
  1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.
  2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition.

### **3.7 CLEANING, DISINFECTION AND PURGING**

- A. Cleaning:
  1. Clean interior of piping systems thoroughly before installing.
  2. Maintain pipe in clean condition during installation.
  3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
  4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.
  5. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.
    - a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.
    - b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to OWNER.
  6. After erection of piping and tubing, but prior to installation of service outlet valves, blow natural gas and liquefied petroleum gas and digester gas systems clear of free moisture and foreign matter by means of air, nitrogen or carbon dioxide.
    - a. Oxygen shall never be used.
  7. Clean chlorine piping in accordance with CI Pamphlet 6.
  8. Purge all neat liquid polymer tubing or piping between the neat polymer storage tank or tote and the polymer blending units with mineral oil to remove residual water prior to introducing neat polymer. Following purging, drain as much of the mineral oil out of the system as possible. Dispose of purged fluids and waste mineral oil in accordance with local environmental regulations.

### **3.8 LOCATION OF BURIED OBSTACLES**

- A. Furnish exact location and description of buried utilities encountered and thrust block placement.
- B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.
- C. Include such information as location, elevation, coverage, supports and additional pertinent information.
- D. Incorporate information on "As-Recorded" Drawings.

### **3.9 PIPE INSULATION**

- A. Insulate pipe and pipe fittings in accordance with Specification Section 40 42 00.

### **3.10 SCHEDULES – SEE PIPE MATERIAL SCHEDULE IN DRAWINGS**

## **END OF SECTION**

## **SECTION 40 05 07**

### **PIPE SUPPORT SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Pipe support and anchor systems.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 05 50 00 - Metal Fabrications.
  - 3. Section 40 42 00 - Pipe, Duct and Equipment Insulation.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B31.1, Power Piping.
    - b. B31.3, Process Piping.
  - 2. ANVIL International (ANVIL).
  - 3. ASTM International (ASTM):
    - a. A36, Standard Specification for Carbon Structural Steel.
    - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
    - c. A510, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
    - d. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
    - e. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
    - f. A917, Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements).
    - g. A918, Standard Specification for Steel Sheet, Zinc-Nickel Alloy Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
    - h. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
  - 4. American Welding Society (AWS):
    - a. D1.1, Structural Welding Code - Steel.
  - 5. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
    - a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
    - b. SP-69, Pipe Hangers and Supports - Selection and Application.
- B. Responsibility:
  - 1. Support systems for piping greater than 18 IN DIA with internal pressure over 100 psi and piping with product temperatures over 200 DegF are shown on the Drawings.
  - 2. Contractor shall design support systems for 18 IN DIA piping and smaller, and for larger diameter piping where supports are not shown on the Drawings.
  - 3. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish and install the system of hangers, supports, guidance, anchorage and appurtenances.
  - 4. General piping support details may be indicated on the Drawings in certain locations for pipe smaller than 12 IN DIA.
  - 5. Contractor shall incorporate those details with requirements of this Specification Section to provide the piping support system.

C. Each type of pipe hanger or support shall be the product of one manufacturer.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
  - c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe support system.
  - d. Scaled drawings showing location, installation, material, loads and forces, and deflection of all hangers and supports.
  - e. Analyze each pipe system for all loads and forces on hangers and supports and their reaction forces to the structure to which they are fastened.
  - f. Support systems for piping systems over 12 IN DIA, systems operating over 100 psig or systems operating over 200 DegF designed by the Contractor: Submit detail design calculations and scaled drawings prepared and signed by a registered Professional Engineer in Maine, showing the requirements of paragraphs d. and e. above.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

### 2.2 MANUFACTURED UNITS

A. General:

1. Galvanized components:
  - a. Electro-galvanized components:
    - 1) Bar, forged or cast fabrications: ASTM B633, SC4.
    - 2) Rolled sheet fabrications: ASTM A917 and ASTM A918, 50N50NU.
  - b. Hot-dipped galvanized components: See Specification Section 05 50 00.
2. Dissimilar metals protection:
  - a. Galvanized-to-galvanized and galvanized-to-aluminum: No protection required.
  - b. All other galvanized-to-dissimilar metal connections: Neoprene or nylon pads, shims, grommets, etc.

B. Hanger Rods:

1. Material:
  - a. ASTM A36.
  - b. ASTM A575, Grade M1020.
  - c. ASTM A576, Grade 1020.
  - d. Minimum allowable tensile stress of 12,000 psi at 650 DegF per MSS SP-58.
2. Continuously threaded.
3. Electro-galvanized or cadmium plated after threads are cut.
4. Load limit:

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 IN DIA (min)	610
1/2 IN DIA	1,130
5/8 IN DIA	1,810

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/4 IN DIA	2,710
7/8 IN DIA	3,770
1 IN DIA	4,960

C. Hangers:

- Hangers for use directly on copper pipe: Copper or cadmium plated.
- Hangers for use other than directly on copper pipe: Cadmium plated or galvanized.
- Hanger type schedule:

APPLICATION	PIPE SIZE	HANGER TYPE
All except noted	4 IN and less	ANVIL Figure 108 with Figure 114
All except noted	Over 4 IN	ANVIL Figure 590
Steam, condensate and hot water	All	ANVIL Figure 181, Figure 82
Service in chemical storage areas and as indicated on drawings for corrosion resistance	All	CorPro CP - Hanger or equal

D. Concrete Inserts for Hanger Rods:

- Continuous slots: Unistrut #P1000.
- Individual inserts: ANVIL Figure 281.

E. Beam Clamps for Hanger Rods:

- Standard duty.
- ANVIL Figure 133.

F. Trapeze Hangers for Suspended Piping:

- General:
  - Material: Steel.
  - Galvanized.
  - Angles, channels, or other structural shapes.
  - Curved roller surfaces at support point corresponding with type of hanger required.
- In chemical storage and feed areas and as indicated on the drawings:
  - Materials: FRP.
  - Unistrut fiberglass channel or equal.

G. Vertical Pipe Supports:

- At base of riser.
- Lateral movement:
  - Clamps or brackets:

H. Expanding Pipe Supports:

- Spring hanger type.
- MSS SP-58.

I. Pipe Support Saddle:

- For pipe located 3 FT or less from floor elevation, except as otherwise indicated on Drawings.
- ANVIL Figure 264.

J. Pipe Support Risers:

- Schedule 40 pipe.
- Galvanized.
- Size: As recommended by saddle manufacturer.

K. Pipe Support Base Plate:

- 4 IN larger than support.

2. Collar 3/16 IN thickness, circular in shape, and sleeve type connection to pipe.
  3. Collar fitted over outside of support pipe and extended 2 IN from floor plate.
  4. Collar welded to floor plate.
  5. Edges ground smooth.
  6. Assembly hot-dipped galvanized after fabrication.
- L. Pipe Covering Protection Saddle:
1. For insulated pipe at point of support.
  2. ANVIL Figure 167, Type B.
- M. Wall Brackets:
1. For pipe located near walls and 8 FT or more above floor elevation or as otherwise indicated on the Drawings.
  2. ANVIL Figure 199.
- N. Pipe Anchors:
1. For locations shown on the Drawings.
  2. 1/4 IN steel plate construction.
  3. Hot-dipped galvanized after fabrication.
  4. Designed to prevent movement of pipe at point of attachment.
- O. Channel Strut & Channel Strut Fittings: per Drawings and manufactured by Cooper/B-Line or Unistrut.
- P. Polyamide Pipe Clamps per Drawings and manufactured by HangerLok or Clic.
- Q. Pipe Guides:
1. For locations on both sides on each expansion joint or loop.
  2. To ensure proper alignment of expanding or contracting pipe.
  3. ANVIL Figure 256.

## 2.3 DESIGN REQUIREMENTS

- A. Supports capable of supporting the pipe for all service and testing conditions.
1. Provide 5 to 1 safety factor.
- B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.
- C. Design supports and hangers to allow for proper pitch of pipes.
- D. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
1. ASME B31.3.
  2. MSS SP-58 and MSS SP-69.
  3. Except where modified by this Specification.
- E. For steam and hot and cold water piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
1. ASME B31.1.
  2. MSS SP-58 and MSS SP-69.
- F. Check all physical clearances between piping, support system and structure.
1. Provide for vertical adjustment after erection.
- G. Support vertical pipe runs in pipe chases at base of riser.
1. Support pipes for lateral movement with clamps or brackets.
- H. Place hangers are to be installed on outside of pipe insulation.
1. Use a pipe covering protection saddle for insulated pipe at support point.
  2. Insulated piping 1-1/2 IN and less:



- a. Provide a 9 IN length of high density perlite or high density calcium silicate at saddle.
  - b. See Specification Section 40 42 00.
- 3. Insulated piping over 1-1/2 IN: Provide a 12 IN length of high density perlite or high density calcium silicate at saddle.
- I. Provide 20 GA galvanized steel pipe saddle for fiberglass and plastic support points to ensure minimum contact width of 4 IN.
- J. Pipe Support Spacing:
  - 1. General:
    - a. Factor loads by specific weight of liquid conveyed if specific weight is greater than water.
    - b. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the Drawings.
    - c. Provide at least one (1) support for each length of pipe at each change of direction and at each valve.
  - 2. Steel, stainless steel, cast-iron pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/2 and less	5
2 thru 4	10
5 thru 8	15
10 and greater	20

- 3. Copper pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
2-1/2 and less	5
3 thru 6	10
8 and greater	15

- 4. PVC pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/4 and less	3
1-1/2 thru 3	4
4 and greater	5

\* Maximum fluid temperature of 120 DegF.

- 5. Support each length and every fitting:
  - a. Bell and spigot piping:
    - 1) At least one (1) hanger.
    - 2) Applied at bell.
  - b. Mechanical coupling joints:
    - 1) Place hanger within 2 FT of each side of fittings to keep pipes in alignment.
- 6. Space supports for soil and waste pipe and other piping systems not included above every 5 FT.
- 7. Provide continuous support for nylon tubing.
- 8. For PVC, FRP and copper piping:
  - a. Provide Unistruct Unicushion wrap of pipe at each support.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable constraints to correct the condition.
  - 1. Included in this requirement are movements from:
    - a. Trap discharge.
    - b. Water hammer.
    - c. Similar internal forces.
- B. Weld Supports:
  - 1. AWS D1.1.
  - 2. Weld anchors to pipe in accordance with ASME B31.3.
- C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.
- D. Inspect hangers for:
  - 1. Design offset.
  - 2. Adequacy of clearance for piping and supports in the hot and cold positions.
  - 3. Guides to permit movement without binding.
  - 4. Adequacy of anchors.
- E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.
- F. Install individual or continuous slot concrete inserts for use with hangers for piping and equipment.
  - 1. Install concrete inserts as concrete forms are installed.
- G. Welding:
  - 1. Welding rods: ASTM and AWS standards.
  - 2. Integral attachments:
    - a. Include welded-on ears, shoes, plates and angle clips.
    - b. Ensure material for integral attachments is of good weldable quality.
  - 3. Preheating, welding and postheat treating: ASME B31.3, Chapter V.

**END OF SECTION**

## **SECTION 40 05 19**

### **PIPE: DUCTILE**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Ductile iron piping, fittings, and appurtenances.
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
    - b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
  - 2. ASTM International (ASTM):
    - a. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - 3. American Water Works Association (AWWA):
    - a. C203, Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
    - b. C606, Standard for Grooved and Shouldered Joints.
  - 4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
    - a. C105/A21.5, Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
    - b. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
    - c. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    - d. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
    - e. C150/A21.50, Standard for Thickness Design of Ductile-Iron Pipe.
    - f. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
    - g. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.
  - 5. Society of Automotive Engineers (SAE):
    - a. AMS-QQ-P-416, Cadmium Plating - Electro-deposited.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 40 05 00.
  - 3. Certification of factory hydrostatic testing.
  - 4. If mechanical coupling system is used, submit piping, fittings, and appurtenant items which will be utilized to meet system requirements.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Flanged adaptors:
    - a. Ford.
    - b. Romac.
    - c. Clow
  2. Grooved coupling:
    - a. Victaulic.
    - b. Grinnel.
    - c. Star
  3. Transition coupling:
    - a. Ford
    - b. Romac
    - c. JCM
  4. Polyethylene encasement tape:
    - a. Chase (Chasekote 750).
    - b. Kendall (Polyken 900).
    - c. 3 M (Scotchrap 50).
  5. Restrained glands
    - a. Sigma
    - b. Ford
    - c. Star
  6. Restrained joints:
    - a. American (Lock Fast) - 12 IN and below.
    - b. U.S. Pipe (TR-Flex) - 4 IN to 54 IN.
    - c. American (Lock Fast) - Above 12 IN.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

### **2.2 MATERIALS**

- A. Ductile Iron Pipe:
1. AWWA/ANSI C115/A21.15.
  2. AWWA/ANSI C150/A21.50.
  3. AWWA/ANSI C151/A21.51.
- B. Fittings and Flanges:
1. AWWA/ANSI C110/A21.10.
  2. AWWA/ANSI C115/A21.15.
  3. Flanges drilled and faced per ASME B16.1 for both 125 and 250 psi applications.
- C. Nuts and Bolts:
1. Buried: Cadmium-plated meeting SAE AMS-QQ-P-416, Type 1, Class 2 (Cor-Ten) for buried application.
  2. Exposed: Mechanical galvanized ASTM B695, Class 40.
  3. Heads and dimensions per ASME B1.1.
  4. Threaded per ASME B1.1.
  5. Project ends 1/4 to 1/2 IN beyond nuts.
- D. Gaskets: See individual piping system requirements in Section 40 05 00.
- E. If mechanical coupling system is used, utilize pipe thickness and grade in accordance with AWWA C606.
- F. Polyethylene Encasement: See AWWA/ANSI C105/A21.5.

G. See Piping Schedules in Section 40 05 00.

## **2.3 MANUFACTURED UNITS**

### **A. Couplings:**

1. Flanged adaptors:
  - a. Unit consisting of steel or carbon steel body sleeve, flange, followers, Grade 30 rubber gaskets.
  - b. Provide units specified in the ACCEPTABLE MANUFACTURERS Article.
  - c. Supply flanges meeting standards of adjoining flanges.
  - d. The working pressure rating of the entire assembly shall be greater than or equal to the test pressure specified on piping schedule for each respective piping application.
2. Mechanical couplings:
  - a. Use of mechanical couplings and fittings in lieu of flanged joints is acceptable where specifically specified in Section 40 05 00.
  - b. Utilize units defined in the ACCEPTABLE MANUFACTURERS Article.

## **2.4 FABRICATION**

- A. Furnish and install without outside coatings of bituminous material any exposed pipe scheduled to be painted.
- B. Furnish cast parts with lacquer finish compatible with finish coat.

## **2.5 LININGS AND COATINGS**

1. Buried pipe and fittings shall have cement lining and asphaltic coating per AWWA/ANSI C104/A21.4.
2. Exposed pipe and fittings shall have cement lining per AWWA/ANSI C104/A21.4 and factory epoxy coating.

## **2.6 SOURCE QUALITY CONTROL**

### **A. Factory Test:**

1. Subject pipe to hydrostatic test of not less than 500 psi with the pipe under the full test pressure for at least 10 seconds.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

### **A. Joining Method - Push-On Mechanical (Gland-Type) Joints:**

1. Install in accordance with AWWA/ANSI C111/A21.11.
2. Assemble mechanical joints carefully according to manufacturer's recommendations.
3. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
4. Do not overstress bolts.
5. Where piping utilizes mechanical joints with tie rods, align joint holes to permit installation of harness bolts.

### **B. Joining Method - Flanged Joints:**

1. Install in accordance with AWWA/ANSI C115/A21.15.
2. Extend pipe completely through screwed-on flanged and machine flange face and pipe in single operation.
3. Make flange faces flat and perpendicular to pipe centerline.
4. When bolting flange joints, exercise extreme care to ensure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress, bending or torsional strains to be applied to cast flanges or flanged fittings.
5. Allow one (1) flange free movement in any direction while bolts are being tightened.

6. Do not assemble adjoining flexible joints until flanged joints in piping system have been tightened.
  7. Gradually tighten flange bolts uniformly to permit even gasket compression.
- C. Joining Method - Mechanical Coupling Joint:
1. Arrange piping so that pipe ends are in full contact.
  2. Groove and shoulder ends of piping in accordance with manufacturer's recommendations.
  3. Provide coupling and grooving technique assuring a connection which passes pressure testing requirements.
- D. Flange Adaptors 12 IN and Less:
1. Locate and drill holes for anchor studs after pipe is in place and bolted tight.
  2. Drill holes not more than 1/8 IN larger than diameter of stud projection.
- E. Cutting:
1. Do not damage interior lining material during cutting.
  2. Use abrasive wheel cutters or saws.
  3. Make square cuts.
  4. Bevel and free cut ends of sharp edges after cutting.
- F. Support exposed pipe in accordance with Sections 40 05 00 and 40 05 07.
- G. Where specified in Section 40 05 00 under individual piping system, install polyethylene encasement in full compliance to AWWA/ANSI C105/A21.5.
1. Encase underground appurtenances required as part of installation.
  2. Make sections 2 FT longer than pipe, fitting, or appurtenance section to be covered.
  3. Slip tube over pipe while pipe is suspended immediately before placing in trench.
  4. After installing in trench, pull tube ends over joint and overlap with any adjacent polyethylene wrap sections.
  5. Fasten securely in-place on each side of each joint with joint tape or strapping.
  6. Completely cover fittings and connections with film held snugly in-place with joint tape or strapping.
- H. Install buried piping in accordance with Section 40 05 00.
- I. Install restrained joint systems where specified in Section 40 05 00 under specific piping system.

### **3.2 FIELD QUALITY CONTROL**

- A. Test piping systems in accordance with Section 40 05 00.

## **END OF SECTION**

## **SECTION 40 05 24**

### **PIPE: STEEL**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Steel pipe, fittings, and appurtenances.
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.

### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
    - b. B1.2, Gages and Gaging for Unified Inch Screw Threads.
    - c. B16.3, Malleable Iron Threaded Fittings.
    - d. B16.5, Pipe Flanges and Flanged Fittings.
    - e. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
    - f. B16.11, Forged Steel Fittings, Socket Welding and Threaded.
    - g. B31.1, Power Piping.
    - h. B31.3, Process Piping.
    - i. B31.9, Building Services Piping.
    - j. Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
  - 2. ASTM International (ASTM):
    - a. A36, Standard Specification for Carbon Structural Steel.
    - b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - c. A181, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
    - d. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
    - e. A283, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
    - f. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
    - g. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
    - h. B6, Standard Specification for Zinc.
    - i. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - 3. American Water Works Association (AWWA):
    - a. C200, Standard for Steel Water Pipe - 6 IN and Larger.
    - b. C203, Standard for Coal-Tar Protective Coatings and Linings for Steel water Pipeline - Enamel and Tape - Hot Applied.
    - c. C205, Standard for Cement-Mortar Lining and Coating for Steel Water Pipe - 4 IN and Larger - Shop Applied.
    - d. C206, Standard for Field Welding of Steel Water Pipe.

- e. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
- f. C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- g. C209, Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
- h. C210, Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
- i. C606, Standard for Grooved and Shouldered Joints.
- j. M11, Steel Pipe - A Guide for Design and Installation.
- 4. Society of Automotive Engineers (SAE):
  - a. AMS-QQ-P-416, Cadmium Plating Electro deposited.
- B. Qualifications:
  - 1. Application of coal tar lining and coating materials including preparation of surfaces, priming, and lining and coating of pipe, fittings, and specials, in shop, repairs of any damage to lining or coating occurring during shipment or any other time, and field lining and coating of ends where linings or coatings have been held back for welded field joints, shall be done by established and recognized pipe company acceptable to Owner.
  - 2. Use only certified welders meeting procedures and performance outlined in ASME Section IX, AWWA C200 Section 3.3.3 and other codes and requirements per local building and utility requirements.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 40 05 00.
  - 3. Factory test reports.
  - 4. If mechanical grooved type coupling system is used, submit piping, fittings, and appurtenant items which will be utilized.
  - 5. Coating manufacturer's qualifications.
  - 6. Welders certificates.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Flanged adaptors:
    - a. Rockwell (Style 913 (steel).
    - b. Dresser (Style 128 (steel).
  - 2. Insulating couplings:
    - a. Rockwell (Style 416).
    - b. Dresser (Style 39).
  - 3. Reducing couplings:
    - a. Rockwell (Style 415).
    - b. Dresser (Style 62).
  - 4. Transition coupling:
    - a. Rockwell (Style 413).
    - b. Dresser (Style 62).
  - 5. Compression sleeve coupling:
    - a. Rockwell (Style 411 (steel).
    - b. Dresser (Style 38 (steel).



6. Mechanical couplings and fittings:
  - a. Victaulic (Style 07 or 77).
  - b. S.P. Fittings.
7. Vibration isolation equipment connections for natural gas:
  - a. Flexonics (Model 401H).
8. Flexible connectors for hot water equipment:
  - a. Flexonics (FLG Series).
  - b. Thermo Tech (F/J/R Series).
9. Factory-applied plastic or epoxy coatings:
  - a. "Encoat" Division of Energy Coating Company.
  - b. "Scotchkote" Division of 3M Company.

B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.2 MATERIALS

- A. All materials used in steel piping systems defined in Section 40 05 00 shall meet or exceed pressure test requirements specified for each respective system.
- B. Steel Pipe (Fabricated Type):
  1. AWWA C200:
    - a. ASTM A36, Grade C steel plate.
    - b. ASTM A283, Grade D steel plate.
    - c. ASTM A572, steel plate.
    - d. ASTM A1011, steel sheet.
- C. Steel Pipe (Mill Type): ASTM A53, Type E or S (Shop painted SCH 80 for outdoor truck fill (with SCH 80 fittings), SCH 40 stainless 316 steel where Drawings indicate (un-painted) for effluent drumfilter spray pump discharge piping (150 psi 316 stainless steel threaded fittings shall be provided)).
- D. Fittings (For Fabricated Pipe): AWWA C208.
- E. Fittings (For Mill Type Pipe):
  1. ASTM A234.
  2. ASME B16.3, ASME B16.5, ASME B16.9, ASME B16.11.
- F. Flanges (Fabricated Pipe):
  1. Flange material: ASTM A283, Grade C or D, ASTM A181, Grade 1.
  2. Flange finish: Flat faced.
- G. Flanges (Mill Type Pipe):
  1. ASME B16.5.
  2. Flat faced.
  3. Slip-on flanges.
- H. Nuts and Bolts:
  1. Buried: Cadmium-plated meeting SAE AMS-QQ-P-416, Type 1, Class 2 (Cor-Ten) for buried application.
  2. Exposed: Mechanical galvanized ASTM B695, Class 40.
  3. Heads and dimensions per ASME B1.1.
  4. Threaded per ASME B1.1.
  5. Project ends 1/4 to 1/2 IN beyond nuts.
- I. Gaskets: See individual piping systems in Section 40 05 00.

## 2.3 MANUFACTURED UNITS

- A. Couplings:
  1. Flanged adaptors:
    - a. Steel or carbon steel body sleeve, flange, followers and Grade 30 rubber gaskets.

- b. Provide units specified in Article 2.1.
  - c. Flanges meeting standards of adjoining flanges.
  - d. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.
2. Compression sleeve coupling:
- a. Steel sleeve, followers Grade 30 and rubber gaskets.
  - b. Provide units specified in Article 2.1.
  - c. Flanges meeting standards of adjoining flanges.
  - d. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.
  - e. Provide field coating for buried couplings per AWWA C203.
3. Mechanical coupling joint:
- a. Use of mechanical grooved (AWWA C606) type couplings and fittings in lieu of flanged joints is acceptable where specifically specified in Section 40 05 00.
  - b. Utilize units defined in Article 2.1.

## 2.4 FABRICATION

- A. Provide piping (mill or fabricated) for use in this Project with minimum wall thicknesses as follows:
- 1. 1/8 - 5 IN DIA pipe: Schedule 40.
  - 2. 6 - 10 IN DIA pipe: 3/16 IN.
  - 3. 12 - 14 IN DIA pipe: 7/32 IN.
  - 4. 16 - 48 IN DIA pipe: 1/4 IN.
  - 5. 54 - 60 IN DIA pipe: 5/16 IN.
  - 6. 66 - 72 IN DIA pipe: 3/8 IN.
  - 7. Sizes through 24 IN are nominal OD.
    - a. Sizes greater than 24 are ID.
  - 8. Wall thicknesses indicated are for standard weight pipe.
    - a. Design pipe in accordance with operating pressures shown in Piping Schedules for a design stress limited to 50 percent of yield.
- B. Furnish cast parts with lacquer finish compatible with finish coating.
- C. Furnish without outside coating of bituminous material any exposed pipe scheduled to be painted.
- D. Fabricated Fittings:
- 1. AWWA C208.
  - 2. Assure ratio of radius of bend to diameter of pipe equal to or greater than 1.0.
- E. Taper cement mortar linings as required for valve interfacing.
- F. Protective Coatings and Linings:
- 1. Provide enamel linings and coatings in accordance with AWWA C203 and the following:
    - a. Potable water: Provide minimum dry film of 5 mils of asphaltic coating non-toxic blend of Gilsonite and brown and steam distilled asphalt.
    - b. Nonpotable fluids: Provide minimum dry film of 5 mils of acceptable asphalt base material.
    - c. Provide coating in accordance with AWWA C203 and subject to following additional requirements.
      - 1) Do not use enamel lined or coated steel pipe exposed to temperatures below 10 DegF.
      - 2) Do not handle enamel-lined or coated pipe when temperature of pipe is below 20 DegF.
      - 3) Coal tar: Provide coal tar enamel having penetration of 15 to 20 at a temperature of 77 DegF.
  - 2. Provide cement mortar lining in accordance with AWWA C205.

3. Provide cement mortar coating in accordance with AWWA C205.
4. Galvanize surface in accordance with hot-dip method using any grade of zinc acceptable to ASTM B6.
5. Wrap pipe in accordance with AWWA C209.

## 2.5 SOURCE QUALITY CONTROL

- A. Testing:
1. Shop hydrostatic test fabricated steel pipe and fittings.
  2. Field hydrostatic test all pipe as specified in Section 40 05 00.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Joining Methods - Flanges:
1. Facing method:
    - a. Insert slip-on flange on pipe.
    - b. Assure maximum tolerances for flange faces from normal with respect to axis of pipe is 0.005 IN per foot of flange diameter.
    - c. Test flanges after welding to pipe for true to face condition and reface, if necessary, to bring to specified tolerance.
  2. Joining method:
    - a. Leave 1/8 to 3/8 IN of flange bolts projecting beyond face of nut after tightening.
    - b. Coordinate dimensions and drillings of flanges with flanges for valves, pumps, equipment, tank, and other interconnecting piping systems.
    - c. When bolting flange joints, exercise extreme care to assure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or cause unnecessary stress, bending or torsional strains being applied to cast flanges or flanged fittings.
      - 1) Allow one (1) flange free movement in any direction while bolts are being tightened.
    - d. Do not assemble adjoining flexible coupled, mechanical coupled or welded joints until flanged joints in piping system have been tightened.
    - e. Gradually tighten flange bolts uniformly to permit even gasket compression.
    - f. Do not overstress bolts to compensate for poor installation.
- C. Joining Method - Welded Joints:
1. Perform welding in accordance with AWWA C206 and this Section.
  2. For flange attachment perform in accordance with AWWA C207.
  3. Have each welding operator affix an assigned symbol to all his welds.
    - a. Mark each longitudinal joint at the extent of each operator's welding.
    - b. Mark each circumferential joint, nozzle, or other weld into places 180 degrees apart.
  4. Welding for all process piping shall conform to ASME B31.3.
    - a. Welding of utility piping 125 psi and less shall be welded per ASME B31.9.
    - b. Utility piping above 125 psi shall conform to ASME B31.1.
  5. Provide caps, tees, elbows, reducers, etc., manufactured for welded applications.
  6. Weldolets may be used for 5 IN and larger pipe provided all slag is removed from inside the pipe.
  7. Weld-in nozzles may be used for branch connections to mains and where approved by Engineer.
  8. Use all long radius welding elbows for expansion loops and bends.
  9. Use long radius reducing welding elbows 90 degree bends and size changes are required.

D. Joining Method - Couplings:

1. Compression sleeve:
  - a. Install coupling to allow space of not less than 1/4 IN but not more than 1 IN.
  - b. Provide harnessed joint.
    - 1) Use joint harness arrangements detailed in AWWA M11.
  - c. Design harness assembly with adequate number of tie rods for test pressures indicated in Section 40 05 00 and allow for expansion of pipe.
  - d. Provide ends to be joined or fitted with compression sleeve couplings of the plain end type.
  - e. Grind smooth welds the length of one (1) coupling on either side of joint to be fitted with any coupling.
  - f. Assure that outside diameter and out-of-round tolerances are within limits required by coupling manufacturer.
2. Mechanical coupling:
  - a. Arrange piping so that pipe ends are in full contact.
  - b. Groove and shoulder ends of piping in accordance with manufacturer's recommendations.
  - c. Provide coupling and grooving technique assuring a connection which passes pressure testing requirements.

E. Joining Method - Threaded and Coupled (T/C):

1. Provide T/C end conditions that meet ASME B1.2 requirements.
2. Furnish pipe with factory-made T/C ends.
3. Field cut additional threads full and clean with sharp dies.
4. Leave not more than three (3) pipe threads exposed at each branch connection.
5. Ream ends of pipe after threading and before assembly to remove burrs.
6. Use Teflon thread tape on male thread in mating joints.

F. Support exposed piping in accordance with Section 40 05 00.

G. Install buried piping per Section 40 05 00.

### **3.2 FIELD QUALITY CONTROL**

A. Test piping systems in accordance with Section 40 05 00.

## **END OF SECTION**

**SECTION 40 05 31**  
**PIPE: PLASTIC**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Plastic pipe.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. See Specification Section 40 05 00.
- B. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. PVC (polyvinyl chloride) materials:
      - 1) D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
      - 2) D1785, Standard Specification for Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80 and 120.
      - 3) D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
      - 4) D2467, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
      - 5) D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
      - 6) D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
      - 7) D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
      - 8) F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
      - 9) F679, Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
    - b. Installation:
      - 1) D2321, Standard Practice for Underground Installation of Thermosplastic Pipe for Sewers and Other Gravity-Flow Applications.
  - 2. American Water Works Association (AWWA):
    - a. PVC (polyvinyl chloride) materials:
      - 1) C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN Through 12 IN, for Water Distribution.
      - 2) C905, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 IN through 48 IN, for Water Transmission and Distribution.
  - 3. NSF International (NSF).

**1.3 SUBMITTALS**

- A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- B. See Specification Section 40 05 00.

## **PART 2 - PRODUCTS**

### **2.1 PVC PRESSURE PIPING (EXPOSED)**

- A. General:
  - 1. Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances to locations shown on Drawings.
  - 2. Furnish materials in full compliance to following material specifications:
    - a. Manufacture pipe, fittings and appurtenances from polyvinyl chloride (PVC) compound which meets the requirements of Type 1, Grade 1 (12454-B) Polyvinyl Chloride as outlined in ASTM D1784.
    - b. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the NSF.
- B. Pipe:
  - 1. Furnish pipe meeting requirements of ASTM D1785.
  - 2. Pipe 2 IN and less to be solvent welded.
  - 3. Pipe larger than 2 IN may be either flanged or solvent welded unless shown otherwise on Drawings.
- C. Fittings: Provide ASTM D2467 PVC socket type fittings having the same pressure and temperature rating as the pipe. Provide bolt-on PVC saddles where Drawings indicate. They shall have 316 stainless steel bolts and resilient seals. Provide PVC socket tank adapters (bulkheads) at round tanks and threaded polyethylene, PVC, stainless or aluminum tank adapter (bulkhead) at mobile tank.
- D. Flanges/Unions:
  - 1. Furnish flanges and unions at locations shown on Drawings.
  - 2. Provide either flanges or unions at valves, penetrations through structures and equipment connections.
  - 3. For pipe larger than 2 IN, provide 150 LB PVC flange.
  - 4. For pipe 2 IN and less, provide socket type PVC union with Buna O-rings.
  - 5. Use flat, full faced natural rubber gaskets at flanged connections.
    - a. Furnish heavy hex head bolts, each with one (1) heavy hex nut, ASTM F593 Type 316 stainless steel.
  - 6. Use spacers supplied by pipe manufacturer when mating raised-faced flanges to other flanges.
- E. Installation:
  - 1. Field threading PVC will not be permitted.
    - a. Perform required threaded connections or attachments by the use of factory molded socket by threaded adapters.
    - b. Female adapters are not acceptable unless specially called for on the Drawings.
  - 2. Employ installation and pipe support practices and solvent welding all in compliance to the manufacturer's printed recommendation.
    - a. Continuously support PVC piping at liquid operating temperatures in excess of 100 DegF.
    - b. For vertical piping, band the pipe at intervals to rigidly support load of twice vertical load.
    - c. Support riser clamps on spring hangers.
    - d. Do not clamp PVC tightly or restrict movement for expansion and contraction.

### **2.2 PRESSURE PIPING (BURIED)**

- A. Materials: Furnish materials in full compliance with following requirements:
  - 1.  $\frac{3}{4}$  - 3 IN & 5 IN: SCH 40 & 80 PVC with solvent cemented joints.
  - 2. 6 IN: SCH 40 or 80 PVC where Drawings specifically indicate

3. 4 & 6-12 IN: DR 25 AWWA C900 PVC rated 165 psi except where Drawings specifically indicate otherwise.
  4. 14-36 IN: AWWA C905 PVC DR-25.
  5. Joints for AWWA PVC pipe shall be the elastomeric-gasket type with a pressure rating not less than pipe pressure rating meeting performance requirements of ASTM D3139.
- B. Installation:
1. Field threading of PVC pipe will not be permitted.
  2. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

## **2.3 PVC DRAINAGE, SEWER PIPING AND UNDERGROUND AIR DUCTS**

- A. Materials:
1. Furnish materials in full compliance to the following material specification.
  2. PVC pipe shall be rigid, unplasticized polyvinyl chloride (PVC) made of PVC plastic having a cell classification of 12454-B or 12454-C as described in specification ASTM D1784.
  3. The requirements of this Specification are intended to provide for pipe and fittings suitable for non-pressure drainage of wastewater and surface water.
  4. Joining systems shall consist of an elastomeric gasket joint meeting requirements of ASTM D3212.
  5. Supply to the Owner all information and sample of joining method for his evaluation.
    - a. Only joining methods acceptable to the Engineer will be permitted.
  6. Provide pipe and fittings meeting or exceeding the following requirements:
    - a. 4-27 IN DIA: ASTM D3034 and ASTM F679, SDR 35 (PS 46) or SDR 26 (PS 115) or SCH 40 DWV PVC where not under roofed structures and not under round tanks. SDR 26 (PS 115) or SCH 40 DWV where under roofed structures and not directly under round tanks.
    - b.  $\frac{3}{4}$  - 5 IN DIA: SCH 40 and SCH 80 (depending on which the Drawings indicate) directly under round tanks
  7. Ensure impact strengths and pipe stiffness is in full compliance to these Specifications.
- B. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.
1. Provide for a maximum deflection of not more than 5 percent.
- C. Infiltration and Exfiltration:
1. The maximum allowable infiltration measured by test shall not exceed 100 GAL per inch of pipe diameter per mile per 24 HRS.
  2. For exfiltration, all the pipe and fittings shall exceed performance requirements by an air test procedure as specified in Section 40 05 00.
  3. Observe full instructions of the Owner for carrying of testing procedures.
    - a. Perform tests only during presence of the Owner or his authorized representative.
  4. Should any test on any section of pipe line disclose either infiltration rates greater than allowed or disclose air loss rate greater than that permitted, locate and repair the defective joints or pipes at no cost to OWNER and retest until requirements stated are met.
- D. Deflection:
1. After backfilling, each section of pipe shall be checked for deflection by pulling a mandrel through the pipe.
  2. Pipe with deflection exceeding 5 percent of the inside diameter shall have backfill removed and replaced to provide a deflection of less than 5 percent.
  3. Any repaired pipe shall be retested.

## **2.4 MANHOLE COVERING AND INSULATION**

- A. HDPE Dual Wall Corrugated Pipe
  - 1. Manufacturers
    - a. JM Eagle
    - b. ADS
    - c. Or Equal
  - 2. Certified ASTM F2306 & F2648
- B. Flexible elastomeric closed cell insulation
  - 1. Manufacturers
    - a. Armacell
    - b. Rubatex
    - c. Or equal
  - 2. Average thermal conductivity not to exceed 0.27 (BTU-IN)/(HR-FT<sup>2</sup>-DEGF) at mean temperature of 75 dgress F, temperature range -40 to 220 degrees F; permeability not to exceed 0.20 by ASTM E9; water absorption 3% by ASTM D1056 and ozone resistance.

## **PART 3 - EXECUTION**

### **3.1 IDENTIFICATION**

- A. Identify each length of pipe clearly at intervals of 5 FT or less.
  - 1. Include manufacturer's name and trademark.
  - 2. Nominal size of pipe, appurtenant information regarding polymer cell classification and critical identifications regarding performance specifications and NSF approvals when applicable.

### **3.2 PRESSURE PIPING (BURIED)**

- A. Installation:
  - 1. Field threading of PVC pipe will not be permitted.
  - 2. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

### **3.3 PVC DRAINAGE, SEWER PIPING AND UNDERGROUND AIR DUCTS**

- A. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.
  - 1. Provide for a maximum deflection of not more than 5 percent.
- B. Infiltration and Exfiltration:
  - 1. The maximum allowable infiltration measured by test shall not exceed 100 GAL per inch of pipe diameter per mile per 24 HRS.
  - 2. For exfiltration, all the pipe and fittings shall exceed performance requirements by an air test procedure as specified in Section 40 05 00.
  - 3. Observe full instructions of the Owner for carrying of testing procedures.
    - a. Perform tests only during presence of the Owner or his authorized representative.
  - 4. Should any test on any section of pipe line disclose either infiltration rates greater than allowed or disclose air loss rate greater than that permitted, locate and repair the defective joints or pipes at no cost to OWNER and retest until requirements stated are met.
- C. Deflection:
  - 1. After backfilling, each section of pipe shall be checked for deflection by pulling a mandrel through the pipe.
  - 2. Pipe with deflection exceeding 5 percent of the inside diameter shall have backfill removed and replaced to provide a deflection of less than 5 percent.



3. Any repaired pipe shall be retested.

**END OF SECTION**

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**SECTION 40 05 51**  
**VALVES: BASIC REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. In this and other Division 40 specifications, where “water” is used to describe an application it includes lake water, well water, aerated water, raw water and treated water and “wastewater” includes sanitary waste, drains, storm sewer, effluent and overflow water.
- B. Section Includes:
  - 1. Valving, actuators, and valving appurtenances.
- C. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 01 61 03 - Equipment: Basic Requirements.
  - 3. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.
  - 4. Section 40 05 52 - Miscellaneous Valves.
  - 5. Section 40 05 61 - Gate Valves.
  - 6. Section 40 05 62 - Plug Valves.
  - 7. Section 40 05 63 - Ball Valves.
  - 8. Section 40 05 64 - Butterfly Valves.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B1.20.1, Pipe Threads, General Purpose.
    - b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
    - c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - 2. ASTM International (ASTM):
    - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
    - c. D638, Standard Test Method for Tensile Properties of Plastics.
    - d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
    - e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
    - f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
  - 3. American Water Works Association (AWWA):
    - a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 through 144 IN.
    - b. C504, Standard for Rubber-Seated Butterfly Valves.
    - c. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
    - d. C550, Standard for Protective Coatings for Valves and Hydrants.
    - e. C606, Standard for Grooved and Shouldered Joints.
  - 4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
    - a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

### **1.3 DEFINITIONS**

- A. The following are definitions of abbreviations used in this Specification Section or one (1) of the individual valve sections:
  - 1. CWP: Cold water working pressure.
  - 2. WOG: Water, oil, gas working pressure.
  - 3. WWP: Water working pressure.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Valve pressure and temperature rating.
    - d. Valve material of construction.
    - e. Special linings.
    - f. Valve dimensions and weight.
    - g. Valve flow coefficient.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 33 00 and 01 33 04 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers.

### **2.2 MATERIALS**

- A. Refer to individual valve Specification Sections.

### **2.3 VALVE ACTUATORS**

- A. Valve Actuators - General:
  - 1. Provide actuators as shown on Drawings or specified.
  - 2. Counter clockwise opening as viewed from the top.
  - 3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
  - 4. Size actuator to produce required torque with a maximum pull of 80 LB at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LB on handwheel or chainwheel or 300 foot-pounds torque on the operating nut.
  - 5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
  - 6. Extension stem:
    - a. Install where shown or specified herein.
    - b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
    - c. Pin all stem connections.
    - d. Center in valve box or grating opening band with guide bushing.
- B. Buried Valve Actuators:

1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover rated for traffic load.
  2. Valve box covers shall be of the locking type with brass threaded bolt and expanding interior jaws.
  3. Box base to enclose buried valve gear box or bonnet.
  4. Provide 2 IN standard actuator nuts complying with AWWA C500, Section 3.16.
  5. Provide at least two (2) tee handle wrenches with foldable handles and length adjustable from 42 to 78" or over a broader range and not more than 15 pounds in weight such as Reed VKA or Geo Glen Enterprises 100433.
  6. Extension stem:
    - a. Provide for buried valves greater than 1.5 FT below finish grade.
    - b. Extend to within 6 IN of finish grade.
  7. Provide concrete pad encasement of valve box as shown for all buried valves unless shown otherwise.
- C. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric or cylinder actuators.
  2. Provide handwheels for gate and globe valves.
    - a. Size handwheels for valves in accordance with AWWA C500.
    - b. Provide 1/8-IN diameter stainless steel loop end cable of sufficient length to lock the handwheel in position to prevent tampering.
    - c. Contractor shall supply common keyed pad locks for all actuators.
  3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.
    - a. Lever actuators for butterfly valves shall have a minimum of 5 intermediate lock positions between full open and full close.
    - b. Lever shall be pad lockable to lock the valve in position and prevent tampering.
    - c. Contractor shall supply common keyed pad locks for all actuators.
    - d. Provide at least two (2) levers for each type and size of valve furnished.
  4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.
  5. Provide gearing for gate valves 20 IN and larger in accordance with AWWA C500.
  6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
  7. Provide chain actuators for valves 6 FT or higher from finish floor to valve centerline.
    - a. Cadmium-plated chain looped to within 3 FT of finish floor.
    - b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.
  8. Provide cast iron floor stands where shown on Drawings.
    - a. Stands to be furnished by valve manufacturer with actuator.
    - b. Stands or actuator to include thrust bearings for valve operation and weight of accessories.

## 2.4 FABRICATION

- A. End Connections:
1. Provide the type of end connections for valves as required in the Piping Schedules presented in Specification Section 40 05 00 or as shown on the Drawings.
  2. Comply with the following standards:
    - a. Threaded: ASME B1.20.1.
    - b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
    - c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.
    - d. Soldered: ASME B16.18.
    - e. Grooved: Rigid joints per Table 5 of AWWA C606.
- B. Refer to individual valve Specification Sections for specifications of each type of valve used on Project.

- C. Nuts, Bolts, and Washers:
  - 1. Wetted or internal to be bronze or stainless steel.
    - a. Exposed to be zinc or cadmium plated.
- D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.
- E. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Setting Buried Valves:
  - 1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
  - 2. Set valves and valve boxes plumb.
  - 3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
  - 4. Install in closed position.
  - 5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
  - 6. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of box.
- C. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.
- D. For grooved coupling valves, install rigid type couplings or provide separate support to prevent rotation of valve from installed position.
- E. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external hand-wheel.
- F. For threaded valves, provide union on one (1) side within 2 FT of valve to allow valve removal.
- G. Install valves accessible for operation, inspection, and maintenance.

### **3.2 ADJUSTMENT**

- A. Adjust valves, actuators and appurtenant equipment to comply with Specification Section 01 75 00.
  - 1. Operate valve, open and close at system pressures.

## **END OF SECTION**

**SECTION 40 05 52**  
**MISCELLANEOUS VALVES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Combination Air Release Valve for impure water
  - 2. Mud Valve
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 01 61 03 - Equipment: Basic Requirements.
  - 3. Section 40 05 51 - Valves: Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
  - 2. American Water Works Association (AWWA):
    - a. C512, Standard for Air-Release, Air-Vacuum, and Combination Air Valves for Waterworks Service.
    - b. C550, Standard for Protective Interior Coatings for Valves and Hydrants.
  - 3. Canadian Standards Association (CSA).
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 40 05 51.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the manufacturers listed below are acceptable.
  - 1. Combination Air Release Valve
    - a. Bermad WW-C50
  - 2. ARI
  - 3. Mud Valve
- B. RW Gate
- C. Submit request for substitution in accordance with Specification Section 01 33 00.

## **2.2 SEWAGE AIR RELEASE VALVE**

- A. Short body, 316 stainless steel and non-ferrous construction, 2-inch inlet with isolation valve (not necessarily by air release maker), at least 150 psi rated, 1- inch or larger outlet connection, drain plug, Crispin AX, Bermad WW-C50-P or ARI D-020.

## **2.3 MUD VALVE**

- A. Materials of Construction
  - 1. All welded stainless steel components shall be constructed of minimum ¼-inch Type 304L or 316L stainless steel.
  - 2. All non-welded stainless steel components, excluding anchor bolts and assembly bolts, shall be Type 304 or 316 stainless steel.
  - 3. Anchor bolts and assembly bolts shall be Type 316 stainless steel.
- B. Assembly
  - 1. The mud valve shall be a one-piece assembly with a non-rising stem, a movable cover and a fixed, integral frame.
  - 2. The frame will be provided with a bolt pattern to mount to a pipe flange or to a concrete floor.
  - 3. The mud valve cover shall be designed to lower into place over the opening for tight shut-off.
    - a. The cover and frame shall be constructed of stainless steel plate.
    - b. A resilient seal shall be mounted to the bottom of the cover. Mud valves with metallic seats are not acceptable.
  - 4. The mud valve base shall be no greater than 3/8" thick.
- C. Operating Stem
  - 1. The operating stem shall be of stainless steel and shall be designed to transmit in compression at least 2 times the rated output of the manual operating mechanism with an 80 lbs effort.
  - 2. The stem shall have a slenderness ratio (L/r) less than 200.
  - 3. The threaded portion of the stem shall have a minimum diameter of 1-1/2 inches.
    - a. The threads shall have machine rolled, full depth ACME threads.
    - b. Stub threads are not acceptable.
  - 4. Stems provided in multiple pieces shall be provided with couplings.
    - a. Couplings shall be bronze or stainless steel and shall be internally threaded and keyed or bolted.
  - 5. Stem guides shall be constructed of stainless steel with UHMWPE bushings.
- D. Operating Mechanism
  - 1. Operating mechanisms shall be provided by the valve manufacturer.
  - 2. Manal operators shall be a 2-inch square operating nut unless otherwise shown on the Contract Documents.
- E. Anchorage
  - 1. Anchor bolts shall be 316 stainless steel, fully threaded and shall have a minimum diameter of ½-inch.
    - a. Anchor bolts shall be of the epoxy type.
- F. Finish
  - 1. All heat tint and slag from the welding process shall be passivated in accordance with ASTM A380

## **2.4 MAINTENANCE MATERIALS**

- A. Provide one (1) set of any special tools or wrenches required for operation or maintenance for each type valve.



- B. PRESSURE RELIEF VALVES: Flanged iron flap check valve such as Waterman PRB-14 or equal by Penn Troy or Neenah.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: See Specification Section 01 61 03 and Specification Section 40 05 51.
- B. Air Release, Vacuum Relief, and Pressure Relief Valves:
  - 1. Pipe exhaust to a suitable disposal point.
  - 2. Where exhausted to a trapped floor drain, terminate exhaust line 6 IN minimum above floor.

### **3.2 FIELD QUALITY CONTROL**

- A. Clean, inspect, and operate valve to ensure all parts are operable and valve seats properly.
- B. Check and adjust valves and accessories in accordance with manufacturer's instructions and place into operation.

**END OF SECTION**

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## **SECTION 40 05 61**

### **GATE VALVES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Gate valves.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 40 05 51 - Valves: Basic Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - 2. American Water Works Association (AWWA):
    - a. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
    - b. C504, Standard for Rubber-Seated Butterfly Valves.
    - c. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
    - d. C515, Standards for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Systems.
    - e. C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.
  - 3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
    - a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
    - b. SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
    - c. SP-80, Bronze Gate, Globe, Angle and Check Valves.

##### **1.3 DEFINITIONS**

- A. NRS: Non-rising Stem.
- B. RS: Rising Stem.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 40 05 51.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

#### **PART 2 - PRODUCTS**

##### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

- B. Submit request for substitution in accordance with Specification Section 01 33 00.

## **2.2 VALVES: WATER, 2-1/2 IN AND SMALLER**

- A. Class 125 bronze gate valve.
- B. Comply with MSS SP-80.
- C. Materials:
  - 1. Body, bonnet, wedge: Bronze.
  - 2. Stem: Silicon bronze.
  - 3. Packing: Aramid fibers with graphite (Kevlar®).
- D. Design Requirements:
  - 1. 125 psi steam, 200 psi nonshock WOG.
  - 2. Screw in bonnet, non-rising stem, solid wedge.
- E. Acceptable Manufacturers:
  - 1. Nibco.
  - 2. Stockham.

## **2.3 VALVES: 3-INCH AND LARGER**

- A. Resilient Wedge Gate Valves, 2 to 48 IN (Water or Wastewater Application):
  - 1. Full port. Comply with AWWA C509.
  - 2. Materials:
    - a. Stem and stem nut: Bronze.
      - 1) Wetted bronze parts in low zinc bronze.
      - 2) Aluminum bronze components: Heat treated per AWWA C504.
    - b. Body, gate: Cast or ductile iron.
    - c. Resilient wedge: Fully encapsulated rubber wedge.
  - 3. Design requirements:
    - a. Minimum 150 psig working pressure.
    - b. Buried: NRS, O-ring stem seal, 2 IN square operating nut.
    - c. Exposed: NRS, O-ring, stem seal, handwheel.
    - d. Counter clockwise open rotation.
    - e. Fusion bonded epoxy coating interior and exterior except stainless steel and bearing surfaces.
      - 1) Comply with AWWA C550.
      - 2) Wetted bronze parts in low zinc bronze.
      - 3) Aluminum bronze components: Heat treated per AWWA C504.
  - 4. Acceptable manufacturers:
    - a. Mueller.
    - b. Matco-Norca
    - c. American Flow Control.
    - d. M & H.
- B. PVC Gate Valves:
  - 1. PVC body with ANSI flanges. Full port.
  - 2. Suitable for throttling.
  - 3. EPDM seat, position indicator, wheel  
Working pressure at least 150 psi.
  - 4. Acceptable manufacturers:
    - a. ASahi America.
    - b. Chemline.

## **2.4 ACCESSORIES**

- A. Refer to Drawings and valve schedule for type of actuators.

1. Furnish actuator integral with valve.
- B. Refer to Specification Section 40 05 51 for actuator requirements.

## **2.5 FABRICATION**

- A. General:
  1. Provide valves with clear waterways the full diameter of the valve.
- B. Spot valves in accordance with MSS SP-9.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. See Specification Section 40 05 51.
- B. Where larger buried valves utilize smaller bypass valves, provide a second valve box installed over the bypass valve operating nut.
- C. Do not install gate valves inverted or with the stems sloped more than 45 degrees from the upright unless the valve was ordered and manufactured specifically for this orientation.

**END OF SECTION**

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## **SECTION 40 05 62**

### **PLUG VALVES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Plug valves.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 40 05 51 - Valves: Basic Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
  - 2. ASTM International (ASTM):
    - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
    - b. A536, Standard Specification for Ductile Iron Castings.
    - c. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
  - 3. American Water Works Association (AWWA):
    - a. C504, Standard for Rubber-Seated Butterfly Valves.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 40 05 51.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.
  - 2. See Specification Section 40 05 51.

#### **PART 2 - PRODUCTS**

##### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

##### **2.2 ECCENTRIC PLUG VALVES (PUMPED FILTER BACKWASH APPLICATIONS)**

- A. Acceptable Manufacturers:
  - 1. DeZurik.
  - 2. GA Industries.
  - 3. ValMatic.

- B. Materials:
1. Body: Cast-iron ASTM A126, Class B.
  2. Plug: One-piece construction ductile iron, ASTM A536 65-45-12 or cast iron, ASTM A126 Class B.
  3. Plug facing: Grease and/or petroleum-resistant resilient Neoprene or Buna-N compound, 70 Type A durometer hardness per ASTM D2240.
  4. Shaft bearing bushings: Permanently lubricated TFE or Delrin sleeve type stainless steel or bronze.
  5. Valve seats: Welded-in overlay of 90 percent nickel, minimum Brinell hardness of 200, (minimum 1/8 IN thick).
  6. Stem seal: Nitrile butadiene packing or Buna-N dual U-cups or bronze cartridge double O-rings with lower grit seal O-ring per AWWA C504, Section 3.7.

## **2.3 ACCESSORIES**

- A. Refer to Drawings and valve schedule for type of actuator.
1. Furnish actuator integral with valve.
- B. Refer to Specification Section 40 05 51 for actuator requirements.

## **2.4 DESIGN REQUIREMENTS**

- A. Non-Lubricated Eccentric Plug Valves:
1. Port area 100%.
  2. Valve body: Fitted with bolted bonnet.
  3. End connections: See Specification Section 40 05 51.
  4. Stem seal: Adjustable and replaceable without disassembling valve or bonnet.
  5. Designed for seating drip tight in any flow direction.
  6. Rating:
    - a. 1/2 through 14 IN, class 125.
  7. Actuator:
    - a. Buried service gear operator.
    - b. Positive identification on actuator indicating valve position.

## **2.5 FABRICATION**

- A. See Specification Section 40 05 51.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. See Specification Section 40 05 51.
- B. Install valves with valve stem horizontal, plug seat on inlet side and with plug rotating up into the open position for valves in horizontal lines.
- C. Install valve with actuator above pipe or plug centerline.

## **END OF SECTION**



## **SECTION 40 05 63**

### **BALL VALVES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Ball valves.
  - 2. Ball curb stop valves
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 40 05 51 - Valves: Basic Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A276, Standard Specification for Stainless Steel Bars and Shapes.
    - b. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
    - c. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
  - 2. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
    - a. SP-110, Ball Valves; Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

##### **1.3 DEFINITIONS**

- A. PVDF: Polyvinylidene fluoride.
- B. PTFE: Polytetrafluoroethylene.
- C. RPTFE: Reinforced PolyTetraFluoroEthylene.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 40 05 51.
  - 3. Test results for AWWA valves.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

#### **PART 2 - PRODUCTS**

##### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

##### **2.2 METALLIC BALL VALVES 1/4 TO 3 IN DIA**

- A. Comply with MSS SP-110.

- B. Acceptable Manufacturers:
  - 1. Apollo.
  - 2. Jamesbury.
  - 3. Watts.
  - 4. Stockham.
  - 5. Nibco.
- C. Materials - all stainless steel:
  - 1. Body: Three-part stainless steel, ASTM A351 CF8M.
  - 2. Ball: Stainless steel ASTM A276.
  - 3. Seats: RPTFE.
- D. Design Requirements:
  - 1. Rated for a minimum of:
    - a. 500 psi CWP.
    - b. 150 psi of saturated steam.
    - c. 29 IN vacuum.
  - 2. Two-position lockable handle. Two-inch square nut in Backwash Lift Station
  - 3. Stem with blowout-proof design.
  - 4. Balancing stop for all applications.
  - 5. Bodies with mounting pad for applications requiring actuators.
  - 6. Full port

## **2.3 PVC BALL AND V PORT PVC BALL VALVES: 1/2 IN TO 4 IN DIA**

- A. Acceptable Manufacturers:
  - 1. Plast-O-Matic
  - 2. ASAHI/America.
  - 3. Georg Fisher
  - 4. Hayward
- B. Materials:
  - 1. Body, ball, stem and end connectors:
    - a. PVC ASTM D1784-12454B.
  - 2. Ball Seat: Teflon.
  - 3. O-rings: EPDM.
- C. Design Requirements:
  - 1. V port ball valves shall have characterized port or 45 degree V port for near linear control. Fully open 2" v-port ball valves shall be rated at least 51 gpm at 1 psi drop and 1" V-port ball valves shall be rated at least 15 gpm at 1 psi drop.
  - 2. SCH 80
  - 3. Full port
  - 4. Rated at 150 psi at 75 DegF.
  - 5. Double or "true union" design.
  - 6. Blocks both directions, upstream and downstream.
  - 7. Union nut capable of compensating for seat wear.
  - 8. Body with mounting pad for actuators where required.
  - 9. Capable of being disconnected at downstream end under full line pressure.

## **2.4 ACCESSORIES**

- A. Refer to Drawings and valve schedule for type of actuators.
  - 1. Furnish actuator integral with valve.
- B. Refer to Specification Section 40 05 51 for actuator requirements.

## **2.5 SOURCE QUALITY CONTROL**

- A. Metal ball valves: Product Testing: MSS SP-110.

## **2.6 BALL CURB STOP VALVES**

- A. Brass, full port ball, one piece tee head and stem, EPDM seats and stem O-rings.
- B. Rated at least 150 psi, FPT threaded ends.
- C. Minneapolis pattern valve with Minneapolis pattern box with lid and lid opening tool and operator wrench.
- D. Ford Meter Box or Mueller

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. See Specification Section 40 05 51.

**END OF SECTION**

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## **SECTION 40 05 64 BUTTERFLY VALVES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Butterfly valves.
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements
  - 2. Division 01 - General Requirements.
  - 3. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.
  - 4. Section 40 05 51 - Valves: Basic Requirements.

#### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B16.5, Pipe Flanges and Flanged Fittings - NPS 1/2 Through NPS 24.
  - 2. ASTM International (ASTM):
    - a. A48, Standard Specification for Gray Iron Castings.
    - b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - c. A276, Standard Specification for Stainless Steel Bars and Shapes.
    - d. A395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
    - e. A436, Standard Specification for Austenitic Gray Iron Castings.
    - f. A536, Standard Specification for Ductile Iron Castings.
  - 3. American Water Works Association (AWWA):
    - a. C504, Standard for Rubber-Seated Butterfly Valves.
  - 4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
    - a. SP-67, Butterfly Valves.

#### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 40 05 51.
  - 3. For valves 8 IN and larger, furnish "Affidavit of Compliance" to Owner in accordance with AWWA C504.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable for metal valves:
  - 1. Val-matic (buried).
  - 2. DeZurik (buried and non-buried).

3. Mueller (buried).
4. Nibco (non-buried).
5. Milwaukee (non-buried).

B. Submit request for substitution in accordance with Specification Section 01 33 00.

## **2.2 PVC BUTTERFLY VALVES:**

- A. PVC or reinforced PP lever that latches in 19 or more positions.
- B. PVC or reinforced PP body, lugged with 316 stainless inserts to mate to ANSI 150 flanges, suitable for dead end service without downstream flange.
- C. Stem extension of 316 ss and ss or factory epoxy coated carbon steel neck extension where Drawings indicate stem and neck extension.
  1. Stem and neck extension assembly shall be furnished by valve manufacturer.
- D. Stem of 316 ss. PVC or PP disc. EPDM seal.
- E. Rated 150 psi, bidirectional.
- F. Acceptable makes & models include Georg Fisher 578, ASAHI/America 57IL, Hayward BYV (except not in extended applications unless provided with gear).

## **2.3 BUTTERFLY VALVES NOT IDENTIFIED AS PVC ON THE DRAWINGS**

- A. For use in all locations, except where PVC butterfly valves are required.
- B. Rated 150 psi or better. Non-buried, non-grooved valves shall comply with MSS-SP-67.
- C. Materials:
  1. Valve bodies:
    - a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
    - b. Grooved end valves may have factory painted carbon steel flanges.
  2. Valve shafts:
    - a. Stainless steel.
    - b. Pins: stainless steel.
    - c. Bushings/Packing/O-rings: EPDM, RTFE or TFE.
    - d. Bearings: Reinforced TFE or equal.
  3. Valve discs:
    - a. Ductile iron with nickel edge or 304 Stainless Steel disc.
  4. Valve seats:
    - a. Water: EPDM or Hycar.
  5. Shaft seal in addition to any sealing provided by seat: Suitable synthetic rubber rings or PTFE V-ring suitable for operating conditions.
- D. Design Requirements:
  1. Seat type: Resilient.
  2. Body type:
    - a. Lugged when exposed and MJ when buried except where Drawings specifically indicate grooved or specifically indicate lugged or wafer in a buried application.
    - b. Lugged shall have fully tapped anchor lugs drilled per ASME B16.5.
  3. Direct buried valves shall meet AWWA 504:
    - a. Buried service gear operator.
    - b. Epoxy coated and lined.
    - c. Box, lid, stem extension and wrench similar to what is specified for buried gate valves.

## **2.4 ACCESSORIES**

- A. Refer to Drawings and/or valve schedule for type of actuators.
  1. Furnish actuator integral with valve.
- B. Refer to Section 40 05 51 for actuator requirements.

C. Valve Flange Seal Rings:

1. If Steel Slip-on flanges are being used on the process piping, flange seals will be required for proper installation of valves.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. See Section 40 05 51.

**END OF SECTION**

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## **SECTION 40 05 66**

### **CHECK VALVES**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Check valves.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 40 05 51 - Valves: Basic Requirements.

##### **1.2 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 40 05 51.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

#### **PART 2 - PRODUCTS**

##### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, manufacturers listed under the valve with types are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

##### **2.2 CHECK VALVES:**

- A. Check valves shall be flanged Swing Check type constructed from PVC Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, ASTM D 1784 Cell Classification 23447, or Polypropylene, ASTM D 4101. All O-rings shall be EPDM or FKM. All valves components shall be replaceable. All valves shall have top-entry access flange for in-line servicing.
- B. All valves shall have external arm and adjustable weight applicable to valves in horizontal and vertical position. All 3/4" - 6-inch valves shall be pressure rated to at least 100 psi for water at 73°F.
- C. Fasteners shall be stainless steel.
- D. Valves shall be flat faced flanged end type conforming to ANSI B16.5 bolt pattern for 150 lb flanges.
- E. Acceptable makers include Spears and ASAHI/America

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. See Specification Section 40 05 51.
- B. Install in accordance with manufacturer's instructions.

**END OF SECTION**

## **SECTION 40 41 13**

### **HEAT TRACING CABLE**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Heat tracing cables and controllers as required for heat tracing of pipes as indicated on the Drawings; two separate cables each on separate thermostat control with alarms.
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Power requirements for each circuit based upon actual length of heat trace and maintained temperature.
    - b. Circuit breaker rating based upon inrush current at minimum expected start-up temperature.
    - c. Length of heat tape for each pipe size and run.
    - d. Coordinate and verify length and Watts/FT of heat tape required based upon pipe size and insulation thickness.
      - 1) Include the calculations to support the heat tape output.
    - e. See Section 26 05 00 for additional requirements.
  - 2. Fabrication and/or layout drawings:
    - a. Wiring diagrams showing physical locations of thermostats and heat trace power supply.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
  - 1. Test reports: Megger test results.

##### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Shall be stored such that they are not exposed to sunlight or other UV rays.

#### **PART 2 - PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
  - 1. Delta-Therm.
  - 2. Chemelex Division; Raychem Corp.
  - 3. Chromalox.

4. Thermon.

## **2.2 HEAT TRACING**

- A. Design Parameters:
  1. Pipe diameter, length and material: See Drawings and relevant piping Specifications.
  2. Flange, valve, pipe support size: See Drawings and relevant piping Specifications.
  3. Pipe insulation type and thickness: See Drawings and relevant piping Specifications.
  4. Temperatures requirements:
    - a. Low ambient temperature for the specific location: -11 DEGF.
    - b. Start-up temperature (alarm thermostat set point):
      - 1) Sludge lines: 40 DEGF.
    - c. Maintain temperature (power thermostat set point):
      - 1) Sludge lines: 40 DEGF.
    - d. High temperature exposure with power off: 185 DEGF.
  5. Wind factor for the specific location: 113 MPH.
  6. Electrical requirements:
    - a. Voltage: 240 V.
    - b. Circuit breaker: 30A GFEPIC type.
  7. Safety factor: 10%.
- B. Self-regulating or power-limiting parallel circuit construction consisting of an inner core of conductive material between parallel copper bus wires, with inverse temperature - conductivity characteristics with metal overbraid.
- C. Thermostats adjustable between 35 and 200 degrees F minimum with maximum differential range of 9 degrees F, furnished complete with NEMA 4 or 4X enclosures in all areas, RTD sensor. Provide controller with low temperature alarm and tripped breaker alarm and dry contact for remote annunciation.
- D. All necessary or required components and accessories, such as power connection boxes, end seals, straps, tape and fitting brackets.
- E. In noncorrosive and nonhazardous locations, insulation shall be Polyolefin.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Install materials after piping has been tested and approved.

### **3.2 INSTALLATION**

- A. Insulate and heat trace wet pipe systems as indicated on Drawings.
- B. Install materials in accordance with manufacturer's instructions.
  1. Each circuit shall not exceed the manufacturer's recommended maximum length.
- C. For Metallic Piping:
  1. Heat tracing shall be installed completely wired.
  2. Cut heat trace to lengths as required and secure to pipe with glass or polyester fiber tape.
- D. For Nonmetallic Piping:
  1. Allow for extra heat trace output because nonmetallic pipe has a lower heat transfer.
    - a. Heat tracing shall be installed completely wired.
  2. Cut heat trace to lengths as required and secure to pipe with aluminum tape throughout the length of the trace.
- E. Protection and Control Requirements:
  1. Protection by a GFEPIC circuit breaker.

- a. Breaker amperage rating shall be coordinated with Contractor when different than the Contract Drawings.
2. Provide line sensing resistance temperature detector (RTD).
3. The alarm thermostat shall be placed on the opposite end of the circuit from the power thermostat or power connection to allow for annunciation of partial failure of a circuit or the loss of power from a tripped GFEPIC circuit breaker.
4. Provide a monitoring module that monitors the voltage (circuit breaker status) to each circuit.
5. The alarm from the alarm thermostat and monitor module shall be annunciated on the indicated control system.

### **3.3 TESTING**

- A. Megger the cables at the manufacturers recommended voltage level three times.
  1. Before installation.
  2. After attachment to pipe but before insulation is installed.
  3. After pipe insulation is installed but before energization.

### **END OF SECTION**

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**SECTION 40 42 00**  
**PIPE, DUCT AND EQUIPMENT INSULATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Insulation:
    - a. Piping insulation.
    - b. Duct insulation.
    - c. Equipment insulation.
  - 2. Adhesives, mastics, caulking, and finishes.
  - 3. Grease and air ventilation duct wrap fire protection systems.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 40 05 07 - Pipe Support Systems.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of Guarded-Hot-Plate Apparatus.
    - b. C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - c. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
    - d. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - e. C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - f. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
    - g. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
    - h. E96, Standard Test Methods for Water Vapor Transmission of Materials.
    - i. F25, Standard Test Method for Sizing and Counting Airborne Particulate Contamination in Cleanrooms and Other Dust-Controlled Areas.
    - j. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
    - k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
    - l. E 119 Standard Method of Fire Tests of Building Construction, 2 Hour Wall Panel Test, 2 Hour External Total Engulfment Test, hose stream evaluation.
    - m. E-136, Combustion Characteristics of Building Materials in a Vertical Tube Furnace.
    - n. E 162, Surface Flammability of Materials.
    - o. E 814, Through-Penetration, 2-Hour Firestop Test.
    - p. E 2336: Standard Test Methods Fire Resistive Grease Duct Enclosure Systems.
  - 2. ISO 6944-1985, Method of Determining Fire Resistance of Ventilation Ducts.
  - 3. National Fire Protection Association (NFPA):
    - a. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
  - 4. Underwriters Laboratories, Inc. (UL):
    - a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.
  - 5. National Commercial and Industrial Insulation Standards (2013 seventh edition).
    - a. Published by Midwest Insulation Contractors Association (MICA).

- b. Endorsed by National Insulation Association (NIA).
- c. MICA plate numbers listed in this specification reference this document.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Submit complete specification of insulation materials, adhesives, cement, together with manufacturer's recommended methods of application and coverage for coatings and adhesives.
  - 3. Submit itemized schedule by building of proposed insulation systems showing density, thermal conductivity, thickness, adhesive, jackets and vapor barriers.
  - 4. Certifications: Products will meet the requirements of the Contract Documents.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Elastomeric insulation:
    - a. Rubatex.
    - b. Armstrong.
  - 2. HDPE jacket:
    - a. See Specification Section 40 05 31
  - 3. Adhesives, mastics, caulking, and finishes:
    - a. Foster Products.
    - b. Childers.
    - c. Dow Corning.
    - d. Johns Manville.
    - e. Knauf.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

### **2.2 PIPING INSULATION - ELASTOMERIC**

- A. General:
  - 1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation), as tested by procedure ASTM E84, NFPA 255 and UL 723, not exceeding:
    - a. Flame spread: 25.
    - b. Smoke developed: 50.
  - 2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed above.
  - 3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed above requirements.
  - 4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.
    - a. Water-soluble treatments are prohibited.
  - 5. Insulated shields at pipe support points.
- B. Pipe, Fitting, and Valve Insulation:
  - 1. Flexible elastomeric closed cell pipe insulation.
    - a. Average thermal conductivity not to exceed 0.27 (Btu-IN)/(HR-FT<sup>2</sup>-DegF) at mean temperature of 75 DegF, temperature range -40 to 220 DegF; permeability not to



- exceed 0.20 by ASTM E96; water absorption 3 percent by ASTM D1056 and ozone resistance.
2. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

## **2.3 PIPING INSULATION - FIBERGLASS**

- A. Pipe and Fitting Insulation:
1. Preformed fiberglass pipe insulation:
    - a. Density: 4 LBS/CF.
    - b. Temperature rated: 650 DegF.
    - c. Average thermal conductivity not to exceed 0.22 (Btu-IN)/(HR-FT<sup>2</sup>-DegF) at mean temperature of 75 DegF.
    - d. Fire hazard rating:
      - 1) UL 723, ASTM E84, NFPA 255.
      - 2) Flame spread not exceeding 25 and smoke developed not exceeding 50.
  2. Moisture adsorption:
    - a. ASTM C553.
    - b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at 120 DegF and 96 percent RH.
  3. Fungi and bacteria resistance:
    - a. ASTM C665.
    - b. Does not breed or promote growth.
    - c. Flame attenuated glass fibers bonded with thermosetting resin.
  4. Piping jackets (general applications):
    - a. Aluminum: 16 mil embossed aluminum.
    - b. PVC: Preformed 0.028 IN thick PVC jackets fabricated from B.F. Goodrich PVC sheeting V-66 with proven resistance to ultraviolet degradation when temperatures do not exceed the limits of PVC.
    - c. Piping jacket not required on concealed piping.
  5. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. General:
1. Piping below ground covered with earth will not be insulated.
  2. Consider ductwork, piping and equipment as exposed, except as otherwise indicated.
  3. Consider ductwork, piping and equipment in walls, partitions, floors, pipe chases, pipe shafts and duct shafts as concealed.
    - a. Consider ductwork, piping and equipment above ceilings as concealed.
  4. Provide release for insulation application after installation and testing is complete.
    - a. Apply insulation on clean, dry surfaces after inspection.
  5. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
  6. Provide insulation with vapor barrier for piping, ductwork and equipment where surfaces may be cooler than surrounding air temperatures.
    - a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.
    - b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
  7. Apply specified adhesives, mastics and coatings at the manufacturer's recommended coverage per unit volume.

- C. Piping Insulation - Elastomeric:
1. Do not insulate until satisfactory completion of required pressure testing.
  2. Apply insulation to clean, dry surfaces.
  3. Slip insulation on pipe prior to connection.
    - a. Whenever the slip-on technique is not possible provide insulation neatly slit and snapped over the pipe.
  4. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
  5. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive, recommended by the insulation manufacturer, to ensure complete vapor barrier.
- D. Piping Insulation - Fiberglass:
1. Apply over clean dry pipe.
    - a. Butt all joints together firmly.
  2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the insulation manufacturer.
  3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
  4. PVC pipe jacket:
    - a. Apply jacketing with a minimum of 1 IN overlap.
      - 1) Weld longitudinal and circumferential seams with adhesives as recommended by manufacturer.
    - b. Provide slip-joints every 30 FT and between fittings if distance exceeds 8 FT.
      - 1) Construct slip-joints by overlapping jacket sections 6 to 10 IN.
    - c. Provide pre-molded PVC covers of same material and manufacturer as jacket for fittings, valves, flanges, and related items in insulated piping systems.
- E. Equipment: Install per manufacturer's instructions.
- F. Ductwork Insulation - Fiberglass:
1. Flexible insulation:
    - a. Butt edges tightly.
      - 1) Secure insulation with Benjamin Foster 85-20 adhesive applied in 6 IN strips on 12 IN centers and/or pins, applied on not more than 18 IN centers so that the insulation conforms to the duct surfaces uniformly and firmly.
    - b. Seal joints with facing overlap or 4 IN wide strips of like facing material adhered and stapled in place.
    - c. Properly seal any penetration in vapor barrier facing with Benjamin Foster 85-20.
    - d. Cut insulation slightly longer than the perimeter of the duct to ensure full thickness at corners.
  2. Semi-rigid insulation:
    - a. Impaling over pins.
      - 1) Apply insulation with edges tightly butted.
      - 2) Apply insulation with mechanically welded fasteners to the duct and secured with speed clips.
      - 3) Clip pins off close to clip.
      - 4) Space pins as required to hold insulation firmly against duct surface but not less than one (1) pin per 1.5 SF.
      - 5) Seal joints and speed clips with 3 IN wide strip of facing adhered with Benjamin Foster 85-20 adhesive.
    - b. If the welded pin method is impossible, secure insulation to the duct with Benjamin Foster 85-20 adhesive.
      - 1) Cover the entire surface of duct with adhesive.
      - 2) Use corner metal angle to protect edge of insulation.
      - 3) Protect edge of insulation.
      - 4) Seal joints as above.
    - c. For outdoor application finish with Benjamin Foster #4610 weatherproof mastic with white glass fabric membrane.

### 3.2 REPAIR

- A. Whenever any factory applied insulation or job-applied insulation is removed or damaged, replace with the same quality of material and workmanship.

### 3.3 SCHEDULES

- A. Refrigeration Lines (35-60 DegF):
1. Elastomeric.
  2. 1/2 IN thickness for lines 1 IN and smaller.
- B. Pipe, Fittings and Valves:
1. Fiberglass.

APPLICATION	PIPE SIZE	THICKNESS	JACKET
Hot Water (domestic)	6 IN and less	3/4 IN	PVC
Cold Water (domestic)	3 IN and less	3/4 IN	PVC
	Over 3 IN	1 IN	
Refrigeration Lines (35 - 60 DegF)	Over 1 IN	1 IN	PVC

- C. Equipment:

EQUIPMENT	INSULATION SYSTEM
Hot water and steam, heating equipment, heat exchangers, air separators, strainers, condensate, receivers	2 IN fiberglass insulation. Glass mesh jacket adhered and coated with two (2) coats of Foster 30-36 white insulation coatings.
Hot water pumps, flash tanks, compression tanks	Uninsulated
Below drain pans serving cooling coils, pre-heat systems, domestic water heaters	1 IN flexible elastomeric closed cell sheet.
Cold water meter	Uninsulated

- D. Ductwork:
1. Fiberglass.

DUCT SERVICE	INSULATION AND THICKNESS	MINIMUM R-VALUE (HR-FT <sup>2</sup> -DegF)/Btu
Outside air ducts, inside building	1-1/2 IN semi-rigid with vapor barrier	6.0
Supply and return air ducts inside building	2 IN flexible with vapor barrier	6.0
Return air duct in non-conditioned areas including shafts	2 IN flexible with vapor barrier	6.0
All other ductwork	Uninsulated	N/A

### END OF SECTION

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**SECTION 40 71 00**  
**FLOW INSTRUMENTATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Flow Transmitters:
    - a. Magnetic Flow Meters (Inline).
- B. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - b. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
    - c. B16.5, Pipe Flanges and Flanged Fittings.
    - d. B626, Standard Specification for Welded Nickel and Nickel-Cobalt Alloy Tube.
    - e. PTC 19.5, Application of Fluid Meters, Part 2.
  - 2. ASTM International (ASTM):
    - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - b. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 3. American Water Works Association (AWWA).
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. WD 1, General Color Requirements for Wiring Devices.
    - c. ICS 6, Industrial Control and Systems: Enclosures.
  - 5. National Sanitation Foundation (NSF).
  - 6. US Department of Interior Bureau of Reclamation (USDIBR):
    - a. Water Measurement Manual.

**1.2 SUBMITTALS**

- A. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 78 23 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.

**2.2 FLOW TRANSMITTERS**

- A. Magnetic Flow Meters (Inline):
  - 1. Acceptable manufacturers:
    - a. McCrometer(Ultra Mag).
    - b. Toshiba (LF654, Mount Anywhere).
    - c. Or Equal.
  - 2. Accessories:

3. Design and fabrication:
  - a. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
  - b. High input impedance pre-amplifiers.
    - 1) Minimum impedance:  $10^{10}$  ohms.
  - c. Provide flanged end connections per ASME B16.5 up to 24 inches rated for piping system operating and test conditions. Meter body shall be rated to same pressure as the flanges.
  - d. Meter shall be rated IP68 and NEMA 6P; capable of temporary submersion for a period of 24 hours under 15 feet of water.
  - e. Grounding requirements:
    - 1) Nonmetallic or lined pipe:
      - a) Inlet and outlet grounding rings of same material as electrode or as recommended by manufacturer to meet process requirements.
    - 2) Conductive piping:
      - a) Conductive path between the meter and the piping flanges.
  - f. Provide cable between magnetic flow meter and transmitter.
    - 1) Cable shall be potted and fitted by manufacturer at the factory.
  - g. Pulsed DC magnetic field excitation.
  - h. Automatic zero.
  - i. Adjustable low flow cutoff.
  - j. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
  - k. Inaccuracy:  $\pm 0.4\%$  of rate.
  - l. 4-20 mA DC isolated output into maximum 800 ohms.
  - m. Power supply: 117 V  $\pm 10\%$ , 60 Hz.
  - n. Indication of flow rate and totalized flow at transmitter.
  - o. Meter operable as specified in liquids with 5.0 micro mho/cm or more conductivity.
  - p. Transmitter electronics shall use microprocessor based architecture and be configured using parameters.
  - q. All meters for drinking water service shall be NSF 61 certified.
  - r. Display shall be able to be mounted remotely on the site.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.

### **3.2 TRAINING**

- A. Provide on-site training in accordance with Specification Section 01 75 00.

## **END OF SECTION**



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## DIVISION 43

**PROCESS GAS AND LIQUID HANDLING,  
PURIFICATION, AND STORAGE EQUIPMENT**



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**SECTION 43 21 00**  
**PUMPING EQUIPMENT - BASIC REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Pumping equipment.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 01 61 03 - Equipment: Basic Requirements.
  - 3. Section 43 21 13. 19 – Overhung Horizontal Self-priming Centrifugal Pumps.
  - 4. Section 43 25 13 - Pumping Equipment: Submersible Non-Clog.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Hydraulic Institute (HI):
    - a. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
    - b. 11.6, Rotodynamic Submersible Pump for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.
    - c. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
- B. Fully coordinate all mechanical seal systems specified to ensure pump and seal compatibility.
- C. Pump/motor and VFD coordination: See Specification Section 01 61 03.

**1.3 DEFINITIONS**

- A. The abbreviations are defined as follows:
  - 1. IPS: Iron Pipe Size.
  - 2. NPSHR: Net Positive Suction Head Required.
  - 3. TDH: Total Dynamic Head.
  - 4. TEFC: Totally Enclosed Fan Cooled.
  - 5. VFD: Variable Frequency Drive.
- B. Pump Service Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 01 61 03.
  - 3. Product technical data including:
    - a. Performance data and curves with flow (gpm), head (FT), horsepower, efficiency, NPSH requirements, submergence requirement.
    - b. Pump accessory data.
    - c. Bearing supports, shafting details and lubrication provisions.
      - 1) Bearing life calculations.
      - 2) Critical speed calculations.
    - d. Solids passage information.
- B. Operation and Maintenance Manuals:

1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
- C. Informational Submittals:
  1. Certifications:
    - a. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by USER's personnel.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Pumps:
    - a. See individual pump Specification Sections.
  2. Mechanical seals:
    - a. Chesterton.
    - b. Garlock.
    - c. Or as noted in the individual pump Specification Sections.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

### **2.2 CENTRIFUGAL PUMP DESIGN**

- A. Provide units with increasing head characteristics from the end run out portion of the curve to shut-off condition.

### **2.3 ACCESSORIES**

- A. See Specification Section 01 61 03.
- B. Mechanical Seals:
  1. Provide as specified in the narrow-scope pump sections.

### **2.4 FABRICATION**

- A. Pump Support:
  1. Design base to support weight of drive, shafting and pump.
  2. Comply with HI vibration limitations.
  3. Support non-submersible pumps from walls on brackets with vibration isolation as recommended by pump maker.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. See Specification Section 01 61 03.
- B. Wall Mounted Units (Non-Submersible):
  1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
  2. Assure no unnecessary stresses are transmitted to equipment flanges.
  3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform gasket compression.
  4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.

5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
  6. Assemble connecting piping with gaskets in place and bolts installed and tightened.
    - a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
    - b. Realign as necessary, install flange bolts and make equipment connection.
  7. Provide pressure gage on discharge of all pumps and on suction and discharge of all non-submersible units.
- C. Submersible Units:
1. Assemble connecting piping with gaskets in place and installed and tightened.
    - a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
    - b. Realign as necessary, install flange bolts and make equipment connection.

### **3.2 FIELD QUALITY CONTROL**

- A. Provide services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by this Specification Section.
  2. Supervise pre-start adjustments and installation checks.
  3. Conduct initial start-up of equipment and perform operational checks.

### **END OF SECTION**

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**SECTION 43 22 56**  
**LIQUID PROCESS EQUIPMENT - SLUDGE TANK MIXING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Self-priming centrifugal chopper pump.
  - 2. Tank mixing nozzles.
- B. Related Sections include but are not necessarily limited to:
  - 1. General Conditions of the Contract for Construction AIA Document (A201-2017) and WV Supplementary Conditions to AIA Document (A201-2017).
  - 2. Division 01 - General Requirements.
  - 3. Section 43 21 00 - Pumping Equipment - Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Iron and Steel Institute (AISI):
    - a. Steel Products Manual.
  - 2. ASTM International (ASTM):
    - a. A48, Standard Specification for Gray Iron Castings.

**1.3 SYSTEM DESCRIPTION**

- A. The mixing system shall consist of a screw pump with a vacuum assist and mixing nozzles located in the sludge storage tank.
- B. Provide single source coordination responsibility through the mixing system manufacturer for the entire system including but not limited to the following:
  - 1. Pump.
  - 2. Motors.
  - 3. Instrumentation and controls.
  - 4. Electrical equipment.
  - 5. Pumping accessories, including vacuum relief and ancillary equipment.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Requirements in Specification Section 43 21 00.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Tank mixing system:
    - a. Vaughan.

- B. Submit request for substitution in accordance with Specification Section 00 72 13.

## **2.2 MATERIALS**

- A. Sludge Pump:
1. Pump volute casing: Ductile iron, Grade 60-40-18.
  2. Pull-Out adapter plate: Ductile iron, Grade 60-40-18.
  3. Impeller: Cast iron, ASTM A48, Grade 30 or ductile iron, Grade 60-40-18.
  4. Cutter Bar: Steel
  5. Upper Cutter: Cast Steel
  6. Cover plate: Cast iron, ASTM A48, Grade 30.
  7. Wear plate: Steel, AISI 1015 or cast iron, Grade 30.
  8. Shaft: Steel, AISI 4140.
  9. Shaft sleeves: Stainless steel, AISI 304.
- B. Nozzles
1. Glass-lined Cast Ductile Iron ASTM A536.
  2. Alternate: Class II, Type C, Chrome Iron ASTM A532.
- C. Nozzle Base
1. Carbon Steel.
  2. Anchor bolts: 316 Stainless Steel.

## **2.3 EQUIPMENT**

- A. Performance and Configuration Requirements:
1. Pumps shall be sized by manufacturer to obtain the necessary mixing of the sludge tank:
    - a. Tank diameter 20 ft.
    - b. Side water depth for wall from bottom of wall to HWL 8 ft 0 in.
    - c. Cone Depth 6 3/4 in (approx.)
    - d. Total volume at HWL 18,800 gallons (approx.).
    - e. Solids content shall be up to 6%.
    - f. Maximum allowable power 10hp, 240V, single ph, 60hz.

## **2.4 ACCESSORIES**

- A. See Section 43 21 00.
1. Provide flushless cartridge mechanical shaft seal with oil reservoir.

## **2.5 PUMP FABRICATION**

- A. Casing and Back-plate:
1. The pump casing shall be of volute design, spiraling outward to the Class 125 flanged centerline discharge. Casing & back-plate shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. A pressure tap shall be included on or near the discharge flange. Back pull-out design shall incorporate adjusting sleeves for accurate adjustment of impeller-to-suction cone clearance, and shall allow removal of pump components without requiring disconnection of casing from inlet or discharge piping. Back-plate shall include a replaceable Rockwell C 60 alloy steel insert cutter to cut against the impeller hub cutter for removing fiber and debris.
- B. Seal:
1. Mechanical Seal system specifically designed to require no seal flush: The mechanical seal shall be located immediately behind the impeller hub to eliminate the stuffing box and maximize the flushing available from the impeller pumpout vanes. The seal shall be a cartridge-type mechanical seal with Viton O-rings and silicon carbide (or tungsten carbide) faces. This cartridge seal shall be a pre-assembled, and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and stainless steel seal housing.



- C. Impeller:
  - 1. Shall be open channel, screw-centrifugal supported by tapered roller bearings and ball bearings. The impeller shall be ductile cast iron and shall be dynamically balanced. The single-passage impeller shall combine the action of a positive displacement screw and a single-vane centrifugal impeller.
- D. Impeller Hub Cutter:
  - 1. Shall be alloy steel heat treat hardened to minimum Rockwell C 60 and fitted into the impeller hub. Hub cutter clearance from the back-plate insert cutter shall be externally adjustable without requiring pump disassembly or special tools.
- E. Shaft Coupling:
  - 1. Bearing housing and motor stool design is to provide accurate, self-aligning mounting for a C-flanged electric motor. Pump and motor coupling shall be T.B. Woods Sureflex elastomeric type.
- F. Belt Drive:
  - 1. Adjustable brackets shall be used to support a side mounted motor. Sheaves and belts shall be properly sized for horsepower ratings, and all guards are to be supplied with the belt drive system.
- G. Bearings:
  - 1. Shaft thrust in both directions shall be taken up by two face to face mounted single-row tapered roller bearings. Ball bearings shall be provided for radial loads. Bearings shall be rated with a minimum L-10 bearing life of 100,000 hours at any acceptable operating point on the performance curve.
- H. Flap Valve:
  - 1. The function of the flap valve is to minimize re-priming time at the start of each pumping cycle. Priming assist mechanisms fitted onto the screw pump shall be provided by the pump manufacturer.
- I. Reprime Performance:
  - 1. The pump shall be capable of a reprime lift of approximately 10-12 ft feet while operating at a selected speed or selected impeller trim.
- J. Rotation:
  - 1. Pump rotation to conform with piping arrangement shown on Drawings.

## **2.6 NOZZLE FABRICATION**

- A. Nozzles:
  - 1. Minimum 1" nominal wall thickness.
  - 2. Minimum straight taper length of 12".
- B. Assembly Fittings:
  - 1. Victaulic pipe connections
  - 2. Minimum glass lining thickness of 0.01".

## **2.7 SYSTEM VENTING**

- A. A venting system shall be required to vent the pump casing before starting the pump.
  - 1. If the casing is a top-discharge configuration, the vent shall be 2"-NPT and tapped into the piping above the pump casing.
  - 2. If the casing is a side-discharge configuration on a horizontal pump or if the pump is a pedestal pump configuration, the casing shall be vented from the ½"-NPT vent on the side of the pump casing. The ½"-NPT connection shall be immediately increased to 2".
  - 3. Install an automatic venting system to the pump casing vent by using either a suitable 2" automatic air release valve. Run discharge piping to either a drain or vented through the roof.

## 2.8 SURFACE PREPARATION

- A. The pump unit shall be SSPC-SP5 sandblasted and prime and finish coat with Tnemec Perma Shield 431. Minimum total thickness of 25-30 MDFT.
- B. Nozzle Assemblies shall be SSPC-SP5 commercial sandblasted and finished with 3M™ Scotchkote™ 134 Fusion Bonded Epoxy Coating. All fasteners shall be 316 stainless steel.

## 2.9 CONTROLS

- A. Control Panel (LCP-241):
  - 1. Furnish and install locally mounted control panel at location shown on Drawings.
  - 2. Provide combination magnetic motor starter(s) with Motor Circuit Protector (MCP) type circuit breaker, NEMA full size contactor with three overload relays and control power transformer (CPT) with two fuses on the primary side and one fuse on the secondary side, for 24 VAC control circuits.
  - 3. Design and fabrication:
    - a. Stainless steel enclosure with NEMA 4X rating:
      - 1) Continuous seam welded.
      - 2) Single front door with continuous hinge, neoprene gasket.
      - 3) Mechanism designed for securing enclosure with padlock.
    - b. Incoming power: 480 VAC, 3-phase.
      - 1) Main circuit breaker with external circuit breaker operating handle.
      - 2) Handle shall include locking tabs that prevent the door from being opened with the breaker in the ON position.
      - 3) Transient Voltage Surge Suppression (TVSS):
        - a) UL 1449 listed.
    - c. Terminal strip for connections to Hatchery Control System.
    - d. Operator controls and indicators located on panel interior swing out door:
      - 1) ON/OFF selector switch.
      - 2) RUNNING light, green lens.
      - 3) OFF light, red lens.
      - 4) Overload FAULT light.
      - 5) Elapsed Time Meter.
      - 6) Control power ON light, white lens.
    - e. Pilot devices:
      - 1) Heavy-duty type.
      - 2) Oil tight, NEMA 4X rating.
      - 3) Mounting hole: 30.5mm.
      - 4) Knob type operators.
      - 5) Push-to-test pilot lights, lens color as indicated.
      - 6) Legend plates:
        - a) Laminated, phenolic plastic with white field and black letters.
        - b) Size: 2 IN x 2 IN.
    - f. Transient Voltage Surge Suppression (TVSS):
      - 1) UL 1449 listed.
      - 2) Maximum lead length 6 IN.
    - g. Condensation protection shall be provided with a space heater.
    - h. Power ON control relay.
  - 4. Hatchery Control System interface requirements:
    - a. Each discrete interface point shall be in the form of a form-C, dry, relay contact wired to terminal blocks.
    - b. The following is a list of interface points required between the Local Control Panel and the Hatchery Control System.
      - 1) Pump RUNNING status (for future use).
      - 2) General Fault shall consist of the following:
        - a) Loss of incoming power.

- b) Pump motor Overload FAULT.
- 5. Fabrication Requirements:
  - a. All internal wiring shall be neat and color coded. Each wire shall be labeled at both ends with a heat-shrinkable wire label. All incoming wires shall terminate into a box clamp type terminal block. All control wires shall be 14 Ga. Type TEW, tinned copper, rated for 105 DegC.
  - b. A schematic diagram (showing wire color) shall be permanently fastened to the inside of the enclosure. An Installation and Service Manual shall also be included with each control panel.
  - c. Apply corrosion inhibitors inside the panel after fabrication and prior to shipment to the jobsite. Inhibitor shall consist of agents that vaporize and then condenses on all internal surfaces of the enclosure.
  - d. Panel shall be factory wired and tested.
  - e. The control panel shall be UL listed as an assembly.
- 6. See Electrical Design for electrical requirements.

## **2.10 SOURCE QUALITY CONTROL**

- A. All Pumps:
  - 1. Hydrostatically test volute at 150 PCT of shut off head.
    - a. Furnish documentation of test.
- B. Factory test one pump of each service category:
  - 1. Measure head (FT) versus flow (GPM).
  - 2. Furnish characteristic curve and include efficiency and horsepower.
  - 3. Certify curves by registered professional engineer.

## **2.11 MAINTENANCE MATERIALS**

- A. Extra Materials:
  - 1. Furnish the Owner the following extra parts:
    - a. Shaft sleeve: One set.
    - b. Bearings: One set.
    - c. Gaskets: One full set.
    - d. Spare mechanical seal: One set.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Comply with requirements of Section 43 21 00.

### **3.2 FIELD QUALITY CONTROL**

- A. See Section 43 21 00.

**END OF SECTION**

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**SECTION 43 22 71**  
**PROCESS POLY TRENCH DRAINS AND FLOOR SINKS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Pre-sloped poly trench drains and floor sinks not connected to sanitary waste.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.

**1.2 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Fabrication and/or layout drawings:
    - a. Layout plan(s) showing dimensions, elevations etc.
    - b. Details showing connections, installation, rough-in locations, etc.
  - 3. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Chemical-resistance data.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 77 00 and 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE TRENCH DRAIN MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Prefabricated trench drain systems:
    - a. ABT Ploydrain.
    - b. Zurn
- B. Submit request for substitution in accordance with Specification Section 00 72 13.

**2.2 TRENCH DRAIN ACCESSORIES**

- A. Grating:
  - 1. Reinforced plastic with bars on 0.6" centers.

**2.3 TRENCH DRAIN FABRICATION**

- A. Trench Sections:
  - 1. Some sections shall have both ends female to receive male ends from both directions.
  - 2. Pre-formed and pre-sloped polymer concrete channel sections.
  - 3. Nominal dimensions per Drawings. Where trench drains are indicated 8 IN or 12 IN inside width, they shall be 12 IN deep at their shallow end. Where trench drains are indicated 4 IN

inside width they shall be 8 IN deep at their shallow end and shall have inside width of at least 4 inches.

4. Sections shall have vertical bottom outlets in sizes indicated in Drawings.
5. Vertical side walls and a radiused bottom.
6. Tongue and groove ends with interlocking adjoining sections.
7. End caps: Same material as channel, design that allows the caps to interlock with channel sections and either close off the end of the channel or provide for drain pipe connection.

## **2.4 FLOOR SINK**

- A. PVC 12 IN x 12 IN x 6 IN with 4 IN outlet, anchor flange, grate & strainer.
  1. Sioux Chief or equal.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Install trench sections with the top edges level and straight at elevations indicated.
  1. Support channel sections in place while concrete is placed under and around sections as indicated.

**END OF SECTION**

**SECTION 43 23 13.19**  
**OVERHUNG HORIZONTAL SELF-PRIMING CENTRIFUGAL PUMPS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Overhung (end-suction), centrifugal, self-priming pumps for process applications.
- B. Related Requirements: Include, but are not necessarily limited to, the following:
  - 1. Section 01 61 03 - Equipment - Basic Requirements.
  - 2. Section 43 21 00 - Pumping Equipment - Basic Requirements.

**1.2 REFERENCES**

- A. Referenced Standards:
  - 1. American Iron and Steel Institute (AISI):
    - a. Steel Products Manual.
  - 2. ASTM International (ASTM):
    - a. A48, Standard Specification for Gray Iron Castings.

**1.3 SUBMITTALS**

- A. Action Submittals: Submit the following:
  - 1. Shop Drawings and Product Data:
    - a. Comply with requirements in Specification Section 43 21 00 - Pumping Equipment - Basic Requirements.
  - 2. Testing Plans: Where the Contract Documents require specific requirements for source quality control activities (shop testing) or field quality control activities (following installation at the Site), submit written testing plan indicating procedures, limitations of testing facilities or instruments, and other relevant information.
- B. Informational Submittals: Submit the following:
  - 1. Activities, indicating compliance with the Contract Documents.
  - 2. Source Quality Control Submittals: Submit written results of source quality control activities, including shop testing and inspections, required in this Section and elsewhere in the Contract Documents.
  - 3. Field Quality Control Submittals: Submit written results of field quality control activities, including tests and inspections of the installed Work at the Site, required in this Section and elsewhere in the Contract Documents.
  - 4. Supplier's Instructions: Submit manufacturer's written instructions for installation, storage, and handling.
  - 5. Supplier's Reports: Submit written report of each visit to the Site by Supplier, indicating reason(s) for visit, problems encountered, solutions implemented, and additional work needed.
- C. Closeout Submittals: Submit the following:
  - 1. Operation and Maintenance Data:
    - a. Submit in accordance with Section 01 78 23 - Operation and Maintenance Data.
- D. Maintenance Materials Submittals
  - 1. Spare Parts and Extra Materials: Furnish the items indicated below, in accordance with Section 01 78 43 - Spare Parts and Extra Materials, and submit documentation of acceptance by Owner or facility manager (if other than Owner):
    - a. Pump and motor manufacturers' recommended supply of spare parts for one year of continuous operation at design conditions, for each size of overhung centrifugal self-priming pump furnished.

- b. One shaft sleeve for all pumps of this type furnished under the Contract.
- c. One set of spare bearings for each size and type of pump furnished..
- d. One complete set of spare gaskets for each size and type of pump furnished.
- e. One spare mechanical seal for each size and type of pump furnished.
- f. One quarter of touch-up paint for finish coat, of each color on pumps furnished.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Self-priming centrifugal pumps:
    - a. Gorman Rupp.
    - b. Or equal.

### **2.2 EQUIPMENT**

- A. Description:
  - 1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals to furnish and install overhung (end-suction) centrifugal self-priming pumps, complete with motors, connection to existing pumping, and other items required and necessary for a complete installation in accordance with the Contract Documents.
- B. Performance and Configuration Requirements:
  - 1. CVP-1 & CHP-1:
    - a. See Self-priming Pump Schedule in the Drawings

### **2.3 MATERIALS**

- A. CVP-1 & CHP-1:
  - 1. Pump volute casing: Cast iron, ASTM A48, Grade 30.
  - 2. Impeller: Cast iron, ASTM A48, Grade 30 or ductile iron, Grade 60-40-18.
  - 3. Cover plate: Cast iron, ASTM A48, Grade 30.
  - 4. Wear plate: Steel, AISI 1015 or cast iron, Grade 30.
  - 5. Shaft: Steel, AISI 4140.
  - 6. Shaft sleeves: Stainless steel, AISI 304.

### **2.4 FABRICATION**

- A. Fabrication - General:
  - 1. Provide each pump with removable cover plates allowing complete access to pump interior.
  - 2. Provide each pump with replaceable wear plates.
  - 3. Entire rotating assembly including bearings, shaft seal, and impeller shall be removable as a unit without disturbing pump volute or piping.
- B. Impeller:
  - 1. Two-vane, semi-open, non-clog type with integral pump out vanes on the back shroud.
  - 2. Provide for external adjustment of the impeller to the wear plate.
- C. Shaft and Sleeve:
  - 1. Size shaft to transmit full drive output.
  - 2. Accurately machine and construct shaft.
  - 3. Contain shaft within bearing pedestal of ample size to contain ball thrust bearing and radial bearing of adequate size to withstand all imposed loads.
  - 4. Incorporate shaft sleeve to protect shaft from pumped liquid.
- D. Bearings:
  - 1. Oil lubricated.
- E. Rotation:



1. Pump rotation to conform with piping arrangement shown on Drawings.

## **2.5 ACCESSORIES**

### **A. Accessors – General:**

1. Comply with Section 43 21 00 - Pumping Equipment - Basic Requirements.
2. Provide mechanical shaft seal with oil reservoir.

## **2.6 SOURCE QUALITY CONTROL**

### **A. Factory Tests and Inspections - All Pumps:**

1. Visually inspect each pump for production and assembly defects. Remedy defectives before packaging, shipping, and subsequent factory tests.
2. Perform manufacturer's normal factory quality control activities and furnish documentation of successful completion.
3. Hydrostatic Testing of Pump Volute:
  - a. Hydrostatically test volute at 150 percent of shut off head.
  - b. Furnish documentation of test.

### **B. Factory Performance Tests:**

1. Factory test (across entire pump curve) one of each size and type of pump furnished for the Contract: Each factory test shall be witnessed by a licensed, registered professional engineer (who need not be licensed and registered in the same jurisdiction as the Site) whose seal and signature shall appear on the performance test results and test curves.
2. Each pump may be factory-tested with a motor electrically identical to the job motor for the associated pump.
3. Measure head (as feet of water) versus flow (GPM). Obtain measurements necessary to accurately calculate and indicate pump efficiency and brake horsepower.
4. Furnish certified pump curve for pump tested, for entire operating range of pump, and indicate associated pump efficiency and brake horsepower.
5. Criteria for Acceptance: In accordance with associated Hydraulic Institute (HI) standard, unless otherwise mutually agreed to by Owner and Contractor.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- ### **A.**
- Comply with requirements of Section 43 21 00 - Pumping Equipment - Basic Requirements, and Section 01 61 03 - Equipment - Basic Requirements..

### **3.2 FIELD QUALITY CONTROL**

- ### **A.**
- Comply with Section 43 21 00 - Pumping Equipment – Basic Requirements, and Section 01 61 03 - Equipment - Basic Requirements.

## **END OF SECTION**

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## **SECTION 43 25 13**

### **SUBMERSIBLE NON-CLOG PUMPS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Submersible non-clog or vortex pumps with hoists, check valves, hatches rail systems and controls for:
    - a. Wet pit application.
      - 1) Drum Filter Backwash Pumps.
      - 2) Gray Water Pumps
      - 3) Sump Pump
  - 2. Deicer
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 26 05 00 - Electrical: Basic Requirements.
  - 3. Section 43 21 00 - Pumping Equipment: Basic Requirements.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American National Standards Institute (ANSI).
  - 2. ASTM International (ASTM):
    - a. A48, Standard Specification for Gray Iron Castings.
  - 3. Hydraulic Institute (HI):
    - a. Standards for Centrifugal, Rotary and Reciprocating Pumps.
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 5. National Fire Protection Agency (NFPA):
    - a. 70, National Electrical Code (NEC):
      - 1) Article 500, Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2.
  - 6. Underwriters Laboratories, Inc. (UL).
    - a. 62, Flexible Cord and Fixture Wire

##### **1.3 SYSTEM DESCRIPTION**

- A. Provide single source coordination responsibility through the pump manufacturer for the system including but not limited to the following:
  - 1. Pumps, motors, controls and switches for Drum Filter Backwash Pumps. Contractor shall coordinate pipe disconnects, check valves, guide rails and brackets, lifting chains, and access hatch not necessarily by pump manufacturer.
  - 2. Pumps, motors, pipe disconnect and rail system for Incubation Chilling Pumps. Contractor shall coordinate access hatch, hoist, switches and VFD's including programming of minimum speeds and avoidance of harmonic speeds.

##### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Requirements in Specification Section 43 21 00.

3. Source quality control test reports.
- B. Operation and Maintenance Manuals:
1. See Specification 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS FILTER BACKWASH PUMPS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Submersible non-clog or vortex pumps:
    - a. Weil.
  2. Rail and Lift Out Check Valve System:
    - a. Jackel Engineered Products
    - b. Topps
    - c. Or Equal.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

### **2.2 MATERIALS**

- A. Wet Pit Applications:
1. Pump case: Cast iron, ASTM A48, Class 30.
  2. Motor housing: Stainless steel or Cast iron, ASTM A48, Class 25 or Class 30.
  3. Impeller: Cast iron, ASTM A48, Class 30.
  4. Shaft:
    - a. Stainless steel, ANSI, Series 300 or 400.
    - b. Carbon steel C1035 is acceptable if not contacting pumped fluid.
  5. Wear rings: Corrosion and wear resistant materials.
  6. O-rings: Nitrile (Buna-N) or fluorocarbon (Viton).
  7. Fasteners: Stainless steel.
  8. Guide rails: Stainless steel.
  9. Lifting chains and cables: Stainless steel.
  10. Seal metal parts: Stainless steel.
  11. Discharge base elbow: Cast iron, ASTM A48 Class 30.

### **2.3 EQUIPMENT**

- A. Performance is scheduled on the Drawings.
- a. Motor service factor at least 1.15 for pumps larger than 3/4 hp.

### **2.4 FILTER BACKWASH PUMP STATION PUMPS (PUMPS OVER ¾ HP)**

- A. General:
1. Provide pumps capable of handling solid sizes schedule one the Drawings.
  2. Where watertight sealing is required, machine and fit mating surfaces with O-rings.
  3. Provide with heavy duty lift lugs or hoisting bail designed for lifting the entire pump and motor assembly.
  4. See also Process (D) Sheets.
- B. Impeller:
1. Provide non-clog type dynamically balanced impeller in accordance with HI standards.
  2. Provide impeller and volute wear rings as necessary to assure efficient sealing between volute and impeller.

- C. Shaft:
  - 1. Design pump shaft of sufficient size to transmit full driver output.
  - 2. Use shaft which is accurately machined and constructed with sufficient materials.
  - 3. Design shaft for a maximum deflection of 0.002 IN measured at the stuffing box.
- D. Shaft Seal:
  - 1. Seal shaft with two seals running in an oil filled chamber. At least one seal face shall be silicon carbide or tungsten carbide.
  - 2. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.
  - 3. Hold interface in contact by its own spring system.
- E. Motors:
  - 1. Provide pump with FM or UL listed motor designed for area classification shown on Drawings.
  - 2. Provide motor of totally submersible design, constructed with epoxy or poly-seal encapsulated windings, air-filled, with Class F or better insulation and rated for continuous duty operation.
  - 3. Assure motor is capable of running dry for extended periods without damage to motor or seal.
  - 4. The motor horsepower provided shall be adequate for all points on the pump curve.
- F. Power and Control Cables:
  - 1. Provide power and control cables which are listed and labeled per NEC requirements and approved for the installation types indicated on the drawings. As a minimum the cable shall be suitable for installation in conduit, submersible applications, and cable tray. The cable and markings shall conform to NEC requirements and indicate AWG size, listing agency, and suitability for installation types listed above.
  - 2. Size cables in accordance with applicable NFPA 70 specifications.
  - 3. Provide length of power cable and control cable as needed for the project base on study of the Drawings.
  - 4. Provide each cable with a strain relief, cord grip, and explosion-proof seal installed in accordance with NFPA 70, Article 500.
  - 5. Minimum acceptable cable type: "SO-Water Resistant" per UL 62
- G. Temperature Monitor:
  - 1. Furnish each phase of the motor with a temperature monitor embedded in the motor windings.
  - 2. Arrange controls so as to shut the pump down and sound alarm should any one of the monitors detect high temperature and automatically reset once the stator temperature returns to normal.
  - 3. Set temperature of the temperature monitors at not higher than 90 percent of insulation temperature rating.
- H. Leak Detection:
  - 1. Provide sensors inside the terminal board and the stator chamber to detect water intrusion
  - 2. If water is detected inside the terminal board or the stator chamber, a switch will stop the pump and sound an alarm.

## **2.5 PUMP ACCESSORIES**

- A. See Specification Section 43 21 00.
- B. Float switches:
  - 1. Provide sealed, float-type mercury switches to control pumps and provide alarm signal.
  - 2. Seal mercury tube switches in a solid polypropylene float.
  - 3. Provide float with large radius top at electrical cable connection to assure trouble-free operation.

4. Suspend floats on a dedicated stainless steel cable stainless steel cable clamps to set level.
5. Provide floats to operate at elevation shown on Drawings.
6. Design floats to be field-adjustable.
7. Six (6) floats:
  - a. One (1) for lead pump start.
  - b. One (1) for lag pump start.
  - c. One (1) for lead pump stop.
  - d. One (1) for lag pump stop.
  - e. One (1) for high level alarm.
  - f. One (1) for low water level alarm and pump shut off.
8. Provide an intrinsically safe relay for each level control circuit to reduce the energy in the circuit to the point that no spark is created by switching.

C. Control Panel

1. Furnish and install locally mounted control panel at location shown on Drawings and rated for area classification.
2. Provide combination magnetic motor starter(s) with Motor Circuit Protector (MCP) type circuit breaker, NEMA full size contactor with three overload relays and control power transformer (CPT) with two fuses on the primary side and one fuse on the secondary side for control circuits.
3. Include a terminal board for connection of level sensors.
4. Provide the following features:
  - a. NEMA 4X
  - b. Hand-Off-Automatic selector switches.
  - c. Automatic alternator.
  - d. High level alarm with alarm horn, silence pushbutton, and alarm light.
  - e. Low level alarm with silence pushbutton and alarm light.
  - f. Pump running lights. See Specification Section 26 24 19 for running light colors.
  - g. Elapsed time meters.
  - h. Overload reset button to reset overload relays.
  - i. Pump sequence selector switch which overrides automatic alternator.
  - j. Transient Voltage Surge Suppression (TVSS):
    - 1) UL 1449 listed.
    - 2) Maximum lead length 6 IN.
  - k. Condensation heater.
  - l. Moisture detector alarm light.
  - m. Motor over-temperature alarm and shutdown.
  - n. Float switch test pushbuttons.
  - o. Auxiliary contacts wired to terminal blocks.
  - p. Power ON control relay.
  - q. Remote telemetering contact.
  - r. 12 VDC alarm system: A safety device which will actuate when faced with an incoming power failure.
  - s. Normal emergency power transfer switch.
  - t. Inner door in cabinet-mounted on a continuous vertical steel hinge; size to completely cover wiring and components mounted on the back panel; provide for mounting of controls and instruments on inner door. Mount to galvanized steel Uni-strut frame/post with stainless steel fasteners.
5. See Electrical Drawings and DIV 26 for electrical requirements.

D. Wet Pit Applications for pumps:

1. Provide sliding guide bracket unit which properly aligns the pump discharge with the discharge connection for watertight seal during pumping.
2. Guide the entire weight of the pumping unit by guide rail(s).
3. The guide rail(s) shall not support any portion of the weight of the pump.
4. Provide chains or cable of sufficient strength to lift pumps from sump.

5. Furnish guiding rail assembly and the discharge assembly of non-sparking components.
  6. Design pump to allow for removal without entering the wet well and without removal of bolts, nuts or other fastenings.
  7. Provide pump unit connecting to discharge connection with a simple downward motion without rotation.
  8. Provide necessary sliding guide bracket and discharge connection which, when bolted to the floor of the sump and to the discharge line, will receive the pump discharge without need of adjustment, fasteners, clamp, or similar devices.
  9. No portion of the pump shall bear directly on the floor or the wet well.
- E. Access Doors and Frames:
1. Furnish and install hinged door of aluminum construction that opens 180 degrees such as offered by USF Fabrication.
  2. Furnish size, door quantity and hinge orientation as shown on Drawings.
  3. Equip with non-sparking upper guide rail support, float bracket, and flush locking mechanism.
  4. Door shall be able to remain in open position while work is being performed.
  5. Securely place frame above pump(s).
  6. Provide doors of skid-proof design.
  7. Provide doors with snap locks and removable handle.
  8. Provide door hardware including latching mechanism and hinges of stainless steel materials.

## **2.6 SOURCE QUALITY CONTROL**

- A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory:
1. Check impeller, motor rating and electrical connections for compliance with this Specification Section.
  2. Test motor and cable insulation for moisture content or insulation defects.
  3. Prior to submergence, run pump dry to establish correct rotation and mechanical integrity.
  4. Run pump for 30 minutes submerged, a minimum of 6 FT under water.
  5. After operational test #4, perform insulation test (#2) again.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. See Specification Section 43 21 00.
- B. For wet pit pumps, permanently install discharge connection elbow in wet well along with discharge piping.
- C. Seal pump cable end with a high quality protective covering, to make it impervious to moisture or water seepage prior to electrical installation.

### **3.2 FIELD QUALITY CONTROL**

- A. See Specification Section 43 21 00.

## **END OF SECTION**

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## DIVISION 46

### WATER AND WASTEWATER EQUIPMENT



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**SECTION 46 13 01**  
**ALUMINUM COVERS - DOME TYPE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Aluminum dome covers and appurtenances
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 26 - Electrical.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Water Works Association (AWWA):
    - a. D-108, Aluminum Dome Roofs for Water Storage Facilities.
  - 2. American Society of Civil Engineers (ASCE):
    - a. 7-10, Minimum Design Loads for Buildings and Other Structures.
    - b. 8-02 Specification for the Design of Cold-Formed Stainless Steel Structural Members.
  - 3. ASTM International (ASTM):
    - a. A276/A276M, Standard Specification for Stainless Steel Bars and Shapes.
    - b. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
    - c. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- B. Qualifications:
  - 1. Manufacturer's Qualifications: Manufacturer shall have experience in designing and manufacturing aluminum dome covers of similar size and configuration to that specified herein. For the manufacturer to be determined acceptable for providing aluminum dome covers on this project, he must show evidence of a minimum of five installations and five years experience in the design and manufacturer of aluminum dome covers of similar size and type as specified herein.
  - 2. Installer/Erector shall be approved, in writing, by manufacturer.
- C. Design frame, skin and anchorage to tank in accordance with the building code, including all requirements of AWWA D108 and ASCE 7-10.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Certification that cover system provided meets or exceeds specified loadings.
  - 2. Certification that the cover system complies with requirements of AWWA D108.
  - 3. Drawings showing dimensional layout and supports.
  - 4. Details of materials of construction.
  - 5. Cover support reactions, sealed by a Professional Engineer registered in the State in which the project is located, so that the Engineer can verify the tank's ability to support the dome.
  - 6. Details on joint attachment, connections, panel attachment, cover/wall interface, attachment of walkway, hatches, light poles and ductwork supports/curbs/details.
  - 7. Horizontal and vertical forces from the cover to wall due to dead load, live load conditions and temperature.
  - 8. Procedure for dome erection.
  - 9. Information to show manufacturer's experience compliance of paragraph 1.2.B.
  - 10. Storage recommendations.

## **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer's delivery, storage and handling recommendations.
- B. Store all aluminum sheet material in a vertical position and keep dry and free of standing water.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. CST Industries
  - 2. Ultraflote LLC
  - 3. Tank Connection

### **2.2 GENERAL**

- A. Dome materials and design shall comply with AWWA D108, latest version, unless modified herein.

### **2.3 MATERIALS**

- A. Domes:
  - 1. Triangulated space truss including struts and gussets: ASTM B308, 6061-T6 or 6005A-T61 aluminum.
  - 2. Triangular closure panels: Minimum 16 GA (0.050 inches) 3003-H16 aluminum sheet.
  - 3. Tension ring: ASTM B308, 6061-T6 or 6005A-T61 aluminum.
  - 4. Fasteners: Anodized 2024-T6 or ASTM B209 7075-T73 aluminum or ASTM A276 stainless steel.
  - 5. Support bearing pads: Stainless steel bearing on Teflon.
  - 6. Fasteners aluminum to steel, ASTM A276, stainless steel, Type 316.
  - 7. Aluminum to steel connection seal: Neoprene.
  - 8. Anchorage: 316 stainless steel.
  - 9. Bottom wall/cover seals: Neoprene or Urethane.

### **2.4 PERFORMANCE AND DESIGN REQUIREMENTS**

- A. Performance and Configuration Requirements:
  - 1. Aluminum dome:
    - a. Application: Sludge Storage Tank.
    - b. Quantity: As shown on Drawings.
    - c. Type of Tank: Reinforced concrete.
    - d. 19 FT Inside Diameter of Tank
    - e. Normal profile.
  - 2. Design loadings:
    - a. Dead loads shall not exceed 5.0 pounds per square foot of surface area.
    - b. Live loads:
      - 1) Symmetrical loading: 30 pounds per square foot over the projected area.
        - a) Apply non-symmetrical and pattern live loads in accordance with the building code.
      - 2) Concentrated panel loading: 250 pounds concentrated on 1 square feet at any point. This load is not to be considered in combination with any other design loads.
      - 3) Distributed load: 60 pounds per square foot distributed over total panel area acting in either the positive or negative direction. This load is not to be considered in combination with any other design loads.
    - c. Snow loads:
      - 1) Design structure for snow loading as set forth in the building code.

- 2) Project site conditions: See Drawing 04S-108.
- 3) Project site conditions are as follows:
  - a) Basic ground snow: 80PSF.
  - b) Importance factor: 1.0.
  - c) Snow exposure coefficient: 1.0.
- d. Wind loadings:
  - 1) Design structure for wind loading as set forth in the building code.
  - 2) Criteria: See Drawing 04S-108.
  - 3) Criteria:
    - a) Basic wind speed: 108 MPH.
    - b) Site exposure: Class C.
    - c) Importance factor: 1.0.
  - 4) Velocity pressure: per ASCE 7-10.
  - 5) Apply horizontal pressures on full dome silhouette as follows:
    - a) Applied to reduced live load side of the "unbalanced loading" condition.
    - b) Applied to full silhouette plus uplift pressure acting normal to the projected surface per ASCE 7.
- e. Seismic loads:
  - 1) Design structure for seismic loading as set forth in the building code.
  - 2) Criteria: See Drawing 04S-108.
  - 3) Criteria:
    - a) Importance factor: 1.0.
    - b) Spectral response acceleration (Ss): 0.236.
    - c) Spectral response acceleration (S1): 0.069.
    - d) Site class: D.
    - e) Spectral response coefficient (Sds): 0.251.
    - f) Spectral response coefficient (Sd1): 0.111.
    - g) Seismic design category: B.
- f. Design dome to withstand stresses due to ambient temperature changes as follows:
  - 1) Low range: -40 degrees F.
  - 2) High range: 130 degrees F.
- g. Capable of 0.5 inches WC induced by ventilation system.
- h. Combine dead, live, snow, wind and seismic loads for design purposes as set forth in the building code, unless otherwise specified.

## 2.5 ACCESSORIES

- A. Process Access Hatches:
  1. 6061-T6, 6005A-T61, 5052-H32 or 3003-H16 aluminum alloys.
  2. 2 units located as shown on Drawings.
  3. 2'-6" x 2'-6" feet.
  4. Stainless steel hinges and hardware.
  5. Neoprene gaskets.
  6. Quick release aluminum latching devices and latch to hold open.
  7. Locate 2'-0" feet above dome base.

## 2.6 FABRICATION

- A. Structure to be fully triangulated space truss complete with non-corrugated closure panels.
- B. Clear spanning dome.
- C. Self-supporting from periphery structure primary horizontal thrust contained by an integral tension ring.
- D. Allow for thermal expansion.
- E. Fabricate dome surface paneling as a watertight system under design load conditions.

- F. Provide tension and compression ring to withstand horizontal dome thrust.
- G. Design dome to support the weight of the duct, duct supports and hangers.
- H. Provide connection points for ductwork as shown on drawings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Fabricate and erect in accordance with manufacturer's instructions and by skilled mechanics with a supervisor experienced in the erection of domes.
- B. Field Measurement:
  - 1. Take field measurements to verify or supplement dimensions indicated on the Drawings.
  - 2. Contractor is responsible for the accurate fit of the work.
- C. Provide sleeve for duct penetrations.
- D. Provide an isolation seal between aluminum to steel connections.
- E. Perform fabrication and erection so dome is plumb, level and in proper alignment.
- F. Field refabrication, weather shielding or force fitting of structural components is not allowed.
- G. Sealant joints shall be tooled slightly concave after sealant is installed.
- H. Take care to keep sealant confined to joint area, and any sealant outside of the joint shall be removed so that the panels will be free from misplaced sealant.
- I. Gasket materials shall be continuous; splices will not be allowed.
- J. Sealants shall be placed only in a manner as recommended by the sealant manufacturer.
- K. Ensure gaskets are continuous in the joint.
- L. Cover raw edges of aluminum panels, seal and firmly clamp in an interlocking manner to prevent slipping or disengagement under all load and temperature changes. Lap sheet designs, which incorporate fasteners that penetrate the panels are not acceptable.
- M. Install continuous, flexible, airtight seal between cover and wall which provides for cover movement. Attach to concrete with strap and set screws.

### **3.2 FIELD QUALITY CONTROL**

- A. Provide dome leak test in accordance with AWWA D108.

## **END OF SECTION**

**SECTION 46 13 15**  
**ALUMINUM COVERS - FORMED PANEL TYPE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Engineered aluminum flat formed or extruded panel covers with encapsulated insulation and appurtenances for the Clarifier. The primary function of the system is to control deter freezing of the clarifier water.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 15 19 - Anchorage to Concrete
  - 2. Section 05 50 00 - Metal Fabrications.
  - 3. Section 05 52 43 - Welded Aluminum Railings.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. The Aluminum Association, Inc. (AA):
    - a. ADM, Aluminum Design Manual, current edition.
    - b. Specifications for Aluminum Structures.
  - 2. American Society of Civil Engineers (ASCE):
    - a. 7, Minimum Design Loads for Buildings and Other Structures.
  - 3. American Welding Society (AWS):
    - a. D1.2, Structural Welding Code - Aluminum.
- B. Qualifications:
  - 1. Manufacturer's Qualifications: Manufacturer shall have experience in manufacturing aluminum covers of similar size and type to the system specified. For a manufacturer to be determined acceptable for providing aluminum covers on this project, they must show evidence of a minimum of five installations and five years' experience in the design and manufacture of systems of similar size and type as specified herein. The manufacturer must design and fabricate the system at its own facilities.
  - 2. Engineer for aluminum covers: Professional Engineer licensed in the State the project is located in.
    - a. Engineer to have minimum five years' experience in design of aluminum covers with scope similar to this Project.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Fabrication and layout drawings showing dimensions, sizes, thicknesses, gauges, materials, finishes, typical details, hatches, attachments and appurtenances.
  - 2. Erection procedures and directions.
  - 3. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  - 4. Certifications:
    - a. Complete set of design drawings and calculations showing the governing stresses in all members and connections signed by a Professional Engineer registered in the State where the project is located. Calculations are submitted for record purposes only, but will be checked for compliance with contract documents.
- B. Project Information:
  - 1. Manufacturer's qualifications to show compliance with Paragraph 1.2.B.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Hallsten.
  - 2. Or Equal

### **2.2 DESCRIPTION**

- A. Covers shall be of hollow double wall aluminum extrusion and the hollow portion shall be filled with marine grade closed cell polystyrene insulation. The panels shall have at least R-5 insulation factor.
- B. Covers shall be an engineered, removable, custom fit, flat formed panel aluminum cover system specifically designed for the requirements specified herein and the areas shown on the Drawings. The covers shall be made of formed sheet aluminum nested panels.
- C. The covers shall be clear-spanning and designed to be self-supporting from the periphery concrete walls and slabs without the use of sub-framing. Anchor to concrete per Section 03 15 19 - Anchorage to Concrete. Provisions shall be made to allow for thermal expansion.
- D. The cover system shall consist of individual panels capable of being removed without needing to remove more than the two adjacent panels. The required lifting force per panel shall not exceed the dead weight of that panel.
- E. The panels shall utilize vertical bends that act as stiffeners to achieve structural rigidity. The bottom of the vertical stiffener shall be further bent to form a joint that allows panels to interlock to each other in order to form a complete cover system. The panel interlock arrangement shall be designed so that no threaded fasteners are required. The ends of the panels shall be sealed with flashing that attaches to the basin wall.
- F. The cover design shall prevent water ponding which may result in excessive infiltration or over-stressing the flat cover. The cover surface paneling shall be designed as a substantially air and water tight system under the specified design loading conditions.
- G. The cover shall enclose the whole clarifier, including under the bridge to further insulate the clarifier from the ambient air.

### **2.3 DESIGN AND MATERIALS**

- A. Materials:
  - 1. Panels, other extrusions and miscellaneous shapes: Alloy 6061-T6. Standard mill finish. Minimum thickness of 0.09 inches.
  - 2. Fasteners and anchor bolts: 316 stainless steel.
  - 3. Sealant: Urethane or Silicone and resistant to ozone and ultraviolet light and conform to Federal Specification TT-S-00230C.
  - 4. Gaskets: Neoprene or Santoprene and shall be resistant to ozone and shielded from exposure to ultraviolet light.
- B. Criteria:
  - 1. Design covers in accordance with the Aluminum Design Manual, ADM-1 as a minimum.
    - a. All loads are unfactored unless otherwise noted.
  - 2. Dead Load: Defined as the weight of the structure and all permanently attached items that are supported by the structure.
  - 3. Live Load:
    - a. Uniform 30 psf on entire cover.
    - b. Concentrated Load: 300 pounds on a 12 inches x 12 inches area.
    - c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.



4. Snow Load: As required per ASCE 7 but not less than required by the building code.
    - a. Importance Factor (I) = 1.0 or greater per ASCE 7 Table 1-1.
    - b. Exposure Factor (Ce) = 1.0 or greater per ASCE 7 Table 7-2.
    - c. Thermal Factor (Ct) = 1.2.
  5. Maximum Weight of any individual removable or operable section: 150 pounds.
  6. Vacuum/Pressure Load: See Sheet 00S-100.
  7. Load Combinations: As required per ASCE 7.
  8. Clear Spans: As shown on the Drawings. No intermediate supports unless otherwise noted.
  9. Deflection: For the above loads and load combinations, the deflection of the structural members shall not exceed L/180, and the cladding shall not exceed L/60 as defined by the Aluminum Association.
  10. Material Design Temperature Range: -40 degrees F to 160 degrees F.
  11. Wind and Seismic: See Sheet 00S-100.
- C. Hinged Equipment Access Hatches:
1. Provide hinged access panels where required for equipment access and at locations shown on the Drawings.
  2. Provide stainless steel hinges and accessories including quick release connection device and latches to hold in place when open. Install neoprene gasket to prevent air leakage.
- D. Sampling Hatches:
1. Sampling hatches shall have OSHA compliant railing with gate all fabricated of aluminum with stainless steel fasteners. Gated railing does not necessarily have to be supplied by the cover manufacturer; but must be coordinated with and supported by the cover manufacturer and the coordination is the responsibility of the Contractor.
  2. Provide 36 inches x 36 inches sampling hatches at locations indicated on the Drawings.
  3. Hatches shall be factory fabricated into the covers. Field cutting for hatch shall not be allowed.
  4. Provide lifting handle and 316 stainless steel full length hinge and full gasketing.
- E. Instrumentation Connections:
1. Provide instrumentation connections at locations and per details shown on the Drawings.
  2. Connections shall be factory fabricated into the covers. Field cutting or fabrication shall not be allowed.
  3. Seal all penetrations.
- F. Covers shall be designed specifically for installation in wastewater treatment plant applications and capable of withstanding corrosion, pitting and degradation from the action of wastewater and associated gases, including hydrogen sulfide in concentrations of up to 200 PPM. The covers shall provide a complete seal for use in an odor control application. Odor control takeoff flanged connections shall be provided at the locations shown on the Drawings. All splice joints shall be interlocked and gasketed.
- G. Dissimilar materials shall be separated from each other through the use of approved gaskets or coatings.

## **PART 3 - EXECUTION**

### **3.1 ERECTION**

- A. Erect all components in accordance with manufacturer's recommendations.
- B. Do not force components during erection.
- C. All work shall be completed by installers skilled and experienced in the erection of similar aluminum products. Covers shall be erected plumb and level and in proper alignment.

### **3.2 FIELD QUALITY CONTROL**

- A. Field re-fabrication of structural components or covers will not be accepted.

### **3.3 CLOSEOUT ACTIVITIES**

**SECTION 46 33 11**  
**CHEMICAL FEED - LIQUID SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Chemical metering pumps for:
  - 2. System accessories.
  - 3. Liquid chemical tanks:
    - a. Storage tanks.
    - b. Holding tanks.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 01 61 03 - Equipment - Basic Requirements.
  - 2. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
  - 3. Section 40 05 51 - Common Requirements for Process and Utility Valves.
  - 4. Section 43 21 00 - Pumping Equipment - Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Secure and coordinate entire system including but not necessarily limited to metering pumps, electric equipment, controls, hardware, valving, and piping through the metering pump manufacturer.

**1.3 SYSTEM DESCRIPTION**

- A. System shall be supplied through a single source and include all components specified herein.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 61 03.
  - 2. Drawings and product data:
    - a. See Specification Section 43 21 00.
    - b. Pump:
      - 1) Chemical resistance data for materials used.
      - 2) Complete performance information:
        - a) Capacity, operating range.
        - b) Pressure rating.
        - c) NPSH required.
        - d) Stroke speed, length.
        - e) Horsepower required.
        - f) Plunger diameter.
    - c. Valves:
      - 1) See Specification Section 40 05 51.
    - d. Piping:
      - 1) See Specification Section 40 05 00.
    - e. Control modes.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:

- a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

## 1.5 SITE CONDITIONS

### A. Pumped Liquid:

LIQUID	SPECIFIC GRAVITY	TEMP DEGF
Ferric Chloride	1.349	50-85

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Metering pumps and accessories:
    - a. Prominent.
    - b. Milton Roy.
    - c. Pulsafeeder.
    - d. Wallace and Tiernan.

### 2.2 METERING PUMPS

#### A. Materials:

1. Mechanical Diaphragm Type - Solenoid-Drive:

	ALUM, HYPOCHLORITE, FERRIC CHLORIDE, PERMANGANATE, FLUOSILICIC ACID, FERROUS SULPHATE, SULPHITES, POLYMER SODIUM HYDROXIDE
Pump Head	PVC or Kynar
Valves	Ceramic <sup>(1)</sup> or Kynar
Diaphragm	Hypalon or Neoprene (EPDM), TFE or PTFE faced
Case	Metal or ABS

<sup>(1)</sup> Stainless steel spring-loaded ball checks for neat polymer.

#### B. Pump Performance and Design Requirements:

1. Units shall have the following characteristics:
  - a. Tag number(s): CP-1.
  - b. Chemical: Ferric Chloride.
  - c. Heads/unit: 1.
  - d. Capacity/head (GPH): 5.
  - e. Discharge pressure (PSI): 20.
  - f. Type diaphragm:
    - 1) Mechanical disc: EPDM.
  - g. Maximum stroke rate (SPM): 200.
  - h. Drive:
    - 1) Solenoid.
  - i. Electrical requirements: 120 volts.

#### C. Pump Fabrication:

1. Pump:

- a. Ball-check inlet and outlet valves.
  - b. Moving parts totally enclosed and self-lubricating.
  - c. Complete external control with 10:1 minimum manual stroke adjustment, adjustable while operating.
  - d. Capable of operating dry without damage to any component.
  - e. Repeatable accuracy: 1% of maximum output or better.
  - f. Nameplate with chemical, capacity (GPH) and pressure (PSI) ratings.
2. Drive:
- a. Motors:
    - 1) TENV.
    - 2) See Specification Section 01 61 03.
  - b. Speed reducers permanently lubricated.
  - c. Hydraulic drives to automatically vent gases and relieve excess pressures.
3. Support:
- a. Mount pump and drive on common support plates.
  - b. Fabricate to withstand all operating loads.
  - c. Provide anchorage of support.
4. Controls:
- a. Solenoid pumps:
    - 1) ON-OFF switch with local speed control (0-100%) and external with pulse control and 4-20 mA analog.
- D. Spare Parts:
- 1. Provide the following spare parts for each metering pump:
    - a. One set "O" rings and gaskets.
    - b. One each diaphragm.
    - c. One set ball checks and seats.

## 2.3 SYSTEM ACCESSORIES

- A. Provide each accessory listed for each metering pump or as shown on Drawings:
- 1. Calibration chamber:
    - a. PVC, graduated in ml.
    - b. Size:
      - 1) Pumps up to 20 gph: 500 ml.
      - 2) Pumps 20 to 40 gph: 1,000 ml.
      - 3) Pumps above 40 gph: 4,000 ml.
    - c. Include isolation ball valve.
  - 2. Pressure relief valve:
    - a. PVC or Kynar with TFE or hypalon with TFE facing diaphragm.
    - b. External pressure setting.
    - c. Sized for pump capacity.
    - d. Pipe discharge to supply tank.
  - 3. Back pressure valve:
    - a. PVC or Kynar with TFE or hypalon with TFE facing diaphragm.
    - b. External pressure setting.
    - c. Sized for pump capacity.
  - 4. Pulsation dampener:
    - a. Wetted components: PVC.
    - b. Sized for 5% variation from average pressure.
    - c. Provide stainless steel pressure gage, 2.5 inches diameter dial, glycerine-filled and gas fill valve.
- B. Miscellaneous Accessories:
- 1. Metering pump wall mount bracket.
  - 2. Suction lance with:
    - a. Separately adjustable low fluid level warning and pump cutoff.

- b. Quick disconnect communication cable.

### **PART 3 - UNION OR OTHER QUICK DISCONNECT FOR FIELD TUBING CONNECTION.EXECUTION**

#### **3.1 INSTALLATION**

- A. See Specification Section 01 61 03.

#### **3.2 DEMONSTRATION**

- A. See Specification Section 01 75 00.

**SECTION 46 43 22**  
**CIRCULAR CLARIFIER EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Clarifier sludge collection mechanism and related accessories.
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 01 61 03 - Equipment - Basic Requirements.
  - 2. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
  - 3. Section 06 85 14 - FRP Weirs and Baffles.
  - 4. Section 43 21 00 - Pumping Equipment - Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Bearing Manufacturers Association (ABMA):
    - a. ABMA 9, Load Ratings and Fatigue Life for Ball Bearings.
  - 2. American Gear Manufacturers Association (AGMA):
    - a. AGMA 2001-D04, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
    - b. AGMA 2001-D04 (Revision of ANSI/AGMA 2001--C95), Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
    - c. AGMA 2004-C08, Gear Materials, Heat Treatment and Processing Manual.
    - d. AGMA 6013-A06, Standard for Industrial Enclosed Gear Drives.
    - e. AGMA 6034-B92, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
  - 3. American Institute of Steel Construction (AISC):
    - a. Steel Construction Manual.
  - 4. American Iron and Steel Institute (AISI).
  - 5. ASTM International (ASTM):
    - a. A36/A36M, Standard Specification for Carbon Structural Steel.
    - b. A48/A48M, Standard Specification for Gray Iron Castings.
    - c. A276/A276M, Standard Specification for Stainless Steel Bars and Shapes.
    - d. A536, Standard Specification for Ductile Iron Castings.
    - e. B148, Standard Specification for Aluminum-Bronze Sand Castings.
    - f. B271/B271M, Standard Specification for Copper-Based Alloy Centrifugal Castings.
  - 6. American Welding Society (AWS):
    - a. D1.1, Structural Welding Code.
  - 7. National Association of Corrosion Engineers (NACE).
  - 8. National Electrical Manufacturers Association (NEMA).
  - 9. Occupational Safety and Health Administration (OSHA).
- B. Qualifications:
  - 1. Utilize workers, procedures and practices which comply with the American Welding Society.
  - 2. Manufacturer's Qualifications:
    - a. Manufacturer shall have experience in designing and manufacturing secondary clarifier mechanisms of similar size and configuration to that specified herein.
    - b. For the manufacturer to be determined acceptable for providing equipment on this project, they must show evidence of a minimum of ten installations and ten years' experience in the design and manufacturer of secondary clarifier mechanisms with diameters equal to, or greater than 90% of the diameter of that specified herein.

### 1.3 SUBMITTALS

- A. Shop Drawings:
  - 1. See Section 01 61 03, Equipment: Basic Requirements.
  - 2. Product technical data including:
    - a. Evidence to show compliance with manufacturer's qualification requirements specified in Paragraph 1.2.B.
    - b. Evidence to show compliance with manufacturer's coordination requirements specified in 1.5.B.
    - c. Acknowledgement that products submitted meet requirements of standards referenced.
    - d. Manufacturer, model and type of all equipment.
    - e. Complete erection and installation information.
    - f. Complete construction details, materials of construction, drawings of mechanisms, drive, gears, gear reducers, bridge, electrical and control diagrams, and other similar information.
    - g. Catalog cut sheets for purchase subcomponents.
    - h. Statement signed by a Professional Engineer registered in the State where the project is located that structural members have been designed to support the loadings specified.
    - i. Manufacturer, model, type and certification of compliance to ABMA 9 bearing life.
    - j. Provide complete solids transport calculations substantiating the suction header design and mechanism tip speed.
      - 1) Provide actual field verified suction header performance data:
        - a) Field verification clarifier to be 85 feet diameter or larger.
        - b) Test site and testing lab shall be identified as well as test methods.
        - c) Calculations alone will not be an adequate substitute for field performance verification data.
    - k. Center column and bridge support calculations.
    - l. Complete process calculations substantiating the size of the center column ports, energy dissipating inlet device (if specified) and flocculating feedwell.
    - m. Size, make, and type of electric motors and drive systems.
    - n. AGMA rated alarm, stall, and ultimate torque capabilities.
  - 3. List and part numbers of manufacturer's recommended spare parts.
- B. Other:
  - 1. Proposed procedures, equipment, personnel, and schedule for equipment testing specified in Part 3.
  - 2. Manufacturer's certification and copy of report and test results verifying completion of checkout, start-up, testing and other related field services specified in Part 3.
  - 3. Details of any revision necessary to adapt the piping, structural, electrical and instrumentation design to the equipment proposed.
  - 4. NACE certification of factory surface preparation and paint application.
- C. Operation and Maintenance Manuals:
  - 1. See Section 01 78 23.

### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Factory Assembly:
  - 1. Assemble each mechanism in factory to ensure proper fit of parts. Annotate parts with erection marks.
  - 2. Disassemble mechanism into largest sections allowed by carrier regulations for shipment.

### 1.5 SYSTEM COORDINATION

- A. Provide single source supply and coordination responsibility through the collection mechanism manufacturer for the complete clarifier mechanism construction.
- B. The tank in which the collection mechanism is to be installed is also to be provided with weirs and baffles as specified in Section 06 85 14 - FRP Weirs and Baffles. The Contractor shall



provide that information to the collection mechanism manufacturer to ensure proper coordination between the two systems. The collection mechanism manufacturer shall provide written confirmation of this coordination being completed with the submittal information of the equipment specified herein.

## **1.6 PROJECT CONDITIONS**

- A. The mostly buried and covered clarifier is to intermittently receive 175 gpm of water with a total suspended solids concentration of 600 mg/l that is backwash from a rotating drumfilter with 40 micron media receiving effluent from trout rearing vessels. Average flow is estimated at 50 gpm. The water will contain uneaten pelletized fish food, fish scales, metabolic fish waste (including solid and dissolved phosphorous) and suspended solids from a stream water source that has an intake screen with 1/4 inch openings. Some of the water will be potable, un-chlorinated well water. Ferric Chloride might be added to the water immediately upstream of the clarifier to deter phosphorous from going out the clarifier overflow. Sludge will be removed intermittently from the clarifier hopper at 75 gpm and from the clarifier suction header at 50 gpm, both by way of 3" dia. suction piping connected to self-priming centrifugal trash pumps.
- B. Wastewater temperature: 35 to 70 degrees F.
- C. Ambient air temperature: -11 to 71 DEGF.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Clear Stream Environmental
    - a. Travis ZURCHER
    - b. Applications Engineer at Clearstream Environmental
    - c. travis.z@clearstreameng.com (801) 319-4027
  - 2. Kusters Water
  - 3. Walker.

### **2.2 PERFORMANCE AND DESIGN CRITERIA**

- A. Clarifier:
  - 1. Tank inside diameter: See Drawings.
  - 2. Sidewater depth: See Drawings.
  - 3. Floor slope: See Drawings.
  - 4. AGMA 20-year continuous rated running torque applied at output of drive unit: 10,000 feet-LBS minimum.
  - 5. Stall or motor cutout torque: 12,000 feet-LBS.
  - 6. Drive output speed: 0.134 RPM.
  - 7. Drive pinion: Single.
  - 8. Feedwell.
    - a. Size: 20 feet DIA.
    - b. Depth below water surface: 8 feet.
    - c. Minimum overall height: 10 feet 2 inches feet.
      - 1) Extend a minimum of 6 inches above the water surface.
  - 9. Maximum influent headloss at Peak Hour Flow: 3.5 inches.
  - 10. Thickness of all submerged and wetted metal members: 1/4 inches minimum.
- B. Structural Design Criteria:
  - 1. Maximum ratio of unbraced length to least radius of gyration (slenderness ratio):
    - a. Compression members: 120.
    - b. Tension members: 240 (for angle about the Z-Z axis).

2. Maximum unit stress at all structural members when subject to twice the drive motor running torque: 130% of AISC allowable stresses.
3. All welding shall conform to AWS D1.1.

## 2.3 MATERIALS

- A. Bridge: Steel, ASTM A36, Grade B or 304 or 316 Stainless Steel, ASTM A276.
- B. Center Column: 304 or 316 Stainless Steel, ASTM A276 or Steel, ASTM A36.
- C. Plate: Steel, ASTM A36 or 304 or 316 Stainless Steel, ASTM A276.
- D. Tube: Steel, ASTM A36 or 304 or 316 Stainless Steel, ASTM A276.
- E. Structural Shapes: Steel, ASTM A36 or 304 or 316 Stainless Steel, ASTM A276.
- F. Feedwell, energy dissipating inlet, center drive cage, suction header and associated support arms and manifold, and all other wetted metal components not indicated to be steel, ASTM A36 or 304 Stainless Steel, ASTM A276.
- G. Drive Mechanism Option 1:
  1. Main Spur Gear:
    - a. Ductile iron: ASTM A536, Grade 80-55-06 or 80-60-03.
    - b. Cast iron: ASTM A48, Class 60 or 50A.
    - c. Forged steel: AISI Grade 4140, 4150 or 4340.
  2. Main Bearings: AISI Grade 52100, Rockwell C64.
  3. Worm and Worm Shaft:
    - a. Ductile iron: ASTM A536, Grade 80-55-06.
    - b. Steel: AISI Grade 8620.
  4. Pinion and Pinion Shaft:
    - a. Ductile iron: ASTM A536, 80-55-06.
    - b. Steel: AISI Grade 4140.
  5. Gear Housing: Gray iron, ASTM A48.
  6. Shear Pins: 2017-T4 aluminum screw machine stock.
  7. Shear Pin Holes: Hardened steel, Rockwell "C" 62-64.
  8. Turntable Base: Gray iron, ASTM A48.
  9. Liner Strips: Steel, Rockwell "C" 38-42.
  10. Drive Dust Shield: Steel, ASTM A36.
  11. Drive Seal: Felt.
  12. Lip Seals: Neoprene.
  13. Wear Strips: Polyurethane.
- H. Drive Mechanism Option 2:
  1. Main Spur Gear: Forged steel AISI Grade 4140.
  2. Main Bearing:
    - a. Bearing Ring: AISI Grade 4140 forged alloy steel, raceways induction hardened to 58-62 Rc.
    - b. Ball material: AISI Grade 52100 chrome steel, hardened to 62-66 Rc.
  3. Pinion: Case hardened 8620 hour steel. AGMA 2001-C95.
  4. Turntable Base: Welded steel. ASTM A36.
  5. Drive Dust Shield: Neoprene/ASTM A36.
  6. Drive Seals: Neoprene.
- I. Fasteners and attachment hardware including anchor bolts:
  1. 316 or 304 Stainless Steel.
  2. Comply with Division 5.
- J. Influent pipe shall be coated and lined steel/ stainless steel, schedule 80 PVC, or fiberglass reinforced plastic.

## 2.4 FABRICATION

### A. Center Column:

1. Hollow cylinder designed to withstand vertical loads, torque loads, and eccentric loads exerted by rotating RAS suction header, skimming collection arms, drive cage, bridge and access platform.
2. Flanged base for anchor-bolting to concrete base of clarifier.
  - a. Provide water tight connection seal.
  - b. Minimum of eight anchor bolts, or as required if more than eight required. Bolt diameter 1 inch minimum.
3. Flanged top and stiffeners for supporting the attached items.
4. Provide a drive mechanism mounting plate set plumb with the centerline of the center pier.
5. Center column shall serve as an influent pipe and have a minimum of four equally spaced ports at the top to direct flow into the influent feedwell at a velocity less than 1 foot/sec.
6. Influent pipe shall be constructed of fiberglass to resist corrosion.
7. Provide easily accessible and removable plate near the bottom of the center column for draining column.
  - a. Removable plate shall provide a clear square opening not less than 18 inches x 18 inches.
  - b. The opening to be reinforced as needed to withstand the imposed loads on the center pier.

### B. Feedwell:

1. The feedwell shall be located outside the energy dissipating inlet device to diffuse the flow into the tank without disturbance or formation of velocity currents.
2. Provide baffled openings in feedwell at liquid level to allow release of skimmings in a tangential direction.
  - a. Minimum four openings.
  - b. Do not locate openings in line with the plumes from the EDI ports.
3. Support the feedwell from drive cage above water level. Feedwell structural members to be on outside of the feedwell to provide smooth interior.
4. Feedwell shall project a minimum of 6 inches above water surface.

### C. Center Drive Cage:

1. All-welded box truss construction.
2. Transmit torque from drive unit to rotating components by the drive cage.
  - a. Do not transmit torque to the access bridge.
3. Design drive cage to encompass center column and support and rotate the suction header and scraper arm.
  - a. Drive cage to transmit and/or carry all torques (including stall torque) without over-stressing members.
  - b. Design cage to withstand 200% of design torque.
4. Design adjustable connection between drive unit and drive cage to provide for proper alignment and allowance for structural tolerance.
5. Attach truss arms to drive cage.
  - a. Provide adjustment arrangement to allow setting the truss arms symmetrically above the clarifier floor and the center drive cage.
  - b. After the truss arms are adjusted and certified by the manufacturer's representative, weld truss arms to center drive cage.

### D. Suction Headers:

1. Provide a rectangular-shaped, fully tapered (two directions) section varying in size from a maximum near the tank center to a minimum at the outer end. Design sections to provide a uniform velocity of removal flow in the header.
2. Provide one header per clarifier extending from the suction header manifold to the tank periphery.

3. The longitudinal cross sectional axis of the header shall be oriented to form a 45 degree angle with the tank floor.
  4. The headers shall be supported from steel truss arms and the center drive cage.
  5. Provide a flanged end connection for bolting the suction headers to the header manifold.
  6. Provide inlet orifices at regular intervals along headers.
    - a. Each orifice shall be designed to withdraw a specific flow rate.
    - b. Not to exceed 30 inches spacing along the header.
    - c. Vary the orifice sizes and locations to assure hydraulic balance in the tank and uniform sludge withdrawal from the entire tank bottom at all flows specified.
    - d. Size orifices and header such that the velocity through the header shall not be less than 0.5 fps at the minimum flow rate and a maximum headloss of 1 foot at maximum flow rate.
  7. Provide a continuous lip flange beneath the orifices that is an integral part of the header to fluidize the sludge and facilitate sludge flow into the orifices.
    - a. Attach a neoprene squeegee with a backing plate to the lip flange.
    - b. Provide slotted holes for a minimum 1 inch vertical adjustment of the squeegee to allow it to conform to the tank bottom.
  8. Near the suction header manifold, provide header with a 1/4 inches plate with neoprene blade to direct sludge from center area to the first orifice, or provide first orifice a minimum of 6 inches from suction header manifold.
- E. Suction Header Support Truss Arms:
1. Fabricate truss arms capable of supporting both the suction headers.
  2. Connections between the truss and suction header shall be of 1/4 inches plate, minimum.
- F. Suction Header Manifold:
1. Provide a suction manifold at the bottom of the tank that is supported by and rotates with drive cage. The manifold shall be designed for transfer of sludge from the suction headers to the outlet pipe.
  2. Provide manifold bottom plate securely anchored to the concrete floor and grouted in place after proper leveling and alignment.
  3. Provide manifold seals to prevent passage of liquid between the tank and the manifold:
    - a. Hold seals in place using a minimum of two stainless steel bands.
    - b. The seal assemblies shall be designed so that replacement can be made without disassembling the manifold.
- G. Drive Mechanism Option 1:
1. Provide a drive mechanism, completely factory assembled, consisting of a motor, primary gear reduction unit, an intermediate reduction unit and a final reduction unit.
  2. Enclose all gearing in a cast iron ASTM A48, Class 40B housing. Exposed gearing and fabricated housings are not acceptable.
  3. Provide all bearings of anti-friction type and running in oil.
  4. Fabricate drive components in accordance with AGMA 2001-D04, 2001-C95 and 6034-B92 for 24 hours continuous duty and 20-year design life based on rated AGMA torque. Design bearings for a B-10 ABMA 9 life of 200,000 hours.
  5. Provide main drive unit with lifting lugs.
  6. Motor:
    - a. Totally enclosed, of ample power for starting and continuously operating the mechanism without overloading.
    - b. Conform to NEMA standards. Name plated for operation on 208V, 3 PH, 60 Hz current.
    - c. Minimum of 3/4 HP and service factor of 1.15.
    - d. Complying with NEMA Design B, and totally enclosed with Class F insulation designed for continuous duty outdoor service.
    - e. See Section 01 61 03, Equipment: Basic Requirements for additional requirements.
  7. Primary reduction unit and chain drive system:

- a. Provide a primary reduction unit which drives the intermediate worm gear reduction unit through a chain and sprocket arrangement.
  - b. Heavy-duty parallel shaft helical type.
  - c. Conform to AGMA 6013-A06, "Standard for Industrial Enclosed Gear Drives," and shall have a minimum service factor of 1.25.
  - d. Furnish drive chain of #80L self-lubricated roller chain and OSHA-approved removable chain guard constructed of molded polyethylene with aluminum back plate.
  - e. The driven sprocket shall include a shear pin overload system to provide overload protection of the drive train. The shear pin assembly shall be easily accessible by removal of the chain guard.
  - f. Provide an adjustable steel base mounted on the intermediate reduction unit for chain tension adjustments.
8. Intermediate reduction unit:
- a. Shall consist of a worm gear driven by an integral straddle mounted worm and shaft, supported by heavy-duty rolling element bearings running in an oil bath.
  - b. Housing shall be cast iron, Class 40B, ASTM A48. Provide with oil fill/drain lines and oil level sight gauge.
  - c. All bearings shall have a minimum L10 life of 20 years, based on the continuous torque rating.
  - d. Service factor of 2.0.
  - e. Mount the unit on a machined face on the top of the final reduction unit and properly aligned to maintain accurate centers for the final reduction gearing.
  - f. Worm assembly: Worm and shaft of A151 8620 heat treated alloy, integral construction.
  - g. Worm gear: Cast manganese bronze conforming to ASTM B271 and AGMA 2004-C08 or aluminum bronze conforming to ASTM B148.
  - h. Overload protection as described in Section 2.5.
9. Final reduction unit and turntable base:
- a. The final gear reduction unit shall consist of a pinion, split internal spur gear, anti-friction ball bearing assembly and housing/base.
  - b. The pinion shall be single piece, without an intermediate coupling, extending from the worm gear to the spur gear, straddle mounted between anti-friction ball or roller bearings to maintain accurate pinion to spur gear alignment and contact.
  - c. Construct the main pinion of AISI Grade 4140/4142 alloy steel, heat treated to a minimum 321 BHN hardness. The pinion shall be manufactured to have a minimum AGMA quality class 8.
  - d. Provide internal spur gear of ductile iron ASTM A536 and AGMA quality class 6 minimum.
  - e. Provide internal gear design to support center cage, collector, and all other rotating components.
  - f. Provide turntable base with annular raceway to contain balls on which the internal gear rotates.
  - g. Furnish ball race without guide shoes and steady bearings.
  - h. Furnish ball bearings of alloy steel per ASTM A295, hardened to 62-66 Rockwell "C", bearing vertically and horizontally on four removable liner strips pressed into annular raceways in turntable base and internal gear.
  - i. Protect internal gear, pinion and ball race by a seal and dust shield.
  - j. Internal gear, pinion and ball race to run in oil bath.
  - k. Furnish turntable base bolted to the center column and designed to support the internal gear with rotating mechanism, access platform, and one end of the access bridge.
  - l. Provide a pipe attached to bottom of turntable base for condensate removal.
  - m. Furnish plugged or capped oil piping which terminates within the center of the base. Provide oil level sight glass and oil drain.
  - n. Provide a turntable assembly designed so that the internal gear, balls and strip liners may be removed without raising the access bridge.

- o. Underwater bearings carrying any part of the load are not acceptable.

H. Drive Mechanism Option 2:

1. Provide a drive mechanism, completely factory assembled, consisting of a solid internal main spur gear, bearing turntable, pinion, secondary speed reducer, support base and drive unit bearing.
2. The drive shall be mounted on the center column and support the entire rotating load of the mechanism.
3. The drive main gear shall be designed to a minimum AGMA 5 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for proper load distribution and sharing. Stub tooth design and surface hardening of the main gear shall not be allowed. All spur gearing shall be designed to the latest AGMA spur gear standard for strength and surface durability, based on a life of 175,000 hours for 24 hour continuous duty. The design running torque rating of the drive gearing shall be based on the smaller of the strength and durability values determined from the above AGMA standard.
4. Bearings shall be of anti-friction type and running in grease or oil. Design bearings for L-10 life of 200,000 hours. The main bearing shall be capable of withstanding the listed overturning moment without the aid of underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.
5. All components of the drive shall be direct coupled.
6. No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.
7. Provide main drive unit with lifting lugs.
8. Welding on the drive unit shall be done using E70XX weld rod.
9. Motor:
  - a. Totally enclosed, of ample power for starting and continuously operating the mechanism without overloading.
  - b. Conform to NEMA standards. Name plated for operation on 208/460V, 3 PH, 60 Hz current.
  - c. Minimum of 3/4 HP and service factor of 1.15.
  - d. Complying with NEMA Design B, and totally enclosed with Class F insulation designed for continuous duty outdoor service.
  - e. See Section 01 61 03, Equipment: Basic Requirements for additional requirements.
10. Primary speed reducing unit:
  - a. The primary speed reducing unit shall be of cycloidal type, totally enclosed. The speed reducer shall be directly connected to the motor without the use of chains or v-belts, and shall be keyed to the pinion.
  - b. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.
  - c. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and shall be grease lubricated. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.
11. Final reduction unit and turntable base:
12. The final gear reduction unit shall consist of a pinion, solid internal main spur gear, turntable base/housing.
13. The drive bearing shall include a precision gear/bearing set, with fully contoured hardened raceways and protected by a neoprene seal. Strip liners designed for periodic maintenance and replacement shall not be acceptable. The drive shall be designed so that the balls and spacers can be replaced without removing the access walkway. The main gear and pinion

shall run in an oil bath or be grease lubricated. If an oil bath is used, an oil sight glass, fill pipe, and drain line shall be provided for the reservoir. If grease lubrication is used, continuous condensate drains shall be provided. Lubrication fittings shall be readily accessible. Ball bearings run in fully contoured races, as part of a precision gear/bearing set. The balls shall be grease lubricated and protected by elastomer seals.

14. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of  $29 \times 10^6$  psi. The center cage shall be fastened to and supported from the gear casing.

I. Access Platforms:

1. Size:
  - a. Provide 3 feet minimum clearance around drive unit assembly for maintenance and service, and access from walkway. Platform shall be a minimum of 8 feet by 8 feet.
2. Fabricate for uniform live load of 300 pounds/SQFT.
3. Construct of 1-1/2 inches deep serrated aluminum grating attached to minimum 1/4 inches structural steel frame, with required stiffeners and supports.
4. Include lift-out sections where required for maintenance of equipment.
5. Provide access platform in compliance with OSHA standards.
6. Provide handrail and toe plate on access platform in compliance of OSHA standards and Section 05 52 43 – Welded Aluminum Railings.

J. Bridge and Walkways:

1. Steel truss-type access bridge.
  - a. Provide 4 feet wide walkways covered with 1-1/2 inches deep serrated aluminum grating.
2. Provide at locations and orientation shown on Drawings.
3. Walkway design:
  - a. Uniform live load of 300 pounds per lineal foot with a maximum deflection of 1/720 of the span.
  - b. Braced against lateral movement using wind load of 50 pounds/SQFT.
4. Provide handrail and toe plate on walkway in compliance of OSHA standards and Section 05 52 43, Welded Aluminum Railings.
5. Provide brackets for supporting electrical conduits.

K. Anchorage:

1. Type 316 stainless steel anchor bolts complete with nuts and washers.
2. Bolt diameter: As required by manufacturer's design, but 1 inch minimum.
3. Provided by the equipment manufacturer.

L. Fasteners:

1. Type 316 stainless steel.
2. Diameter: As required by manufacturer's design, but 1/2 inches minimum.
3. Provided by the equipment manufacturer.

M. Shop or Factory Finishing:

1. Surface preparation and shop or factory painting is required for all ferrous metals, equipment and accessories and shall be as specified in Section 09 96 00.
2. Apply to gears, bearing surfaces, and other unpainted surfaces a heavy application of a rust-resistant coating and maintain coating during storage and until the equipment is placed into operation.
3. All aluminum in contact with dissimilar materials shall be coated as specified in Division 9.

N. Sludge Scraper Truss Arms and Scrapers:

1. Truss arm and scrapers shall be all welded steel construction.
2. Truss arm shall be rigidly braced structural truss arms and rigidly supported by the center drive cage.

3. Tie rods and/or turnbuckle supports from the center drive cage to scraper truss are not acceptable.
4. Provide plows under truss arm.
  - a. Provide smooth, unobstructed face of plow.
5. Sludge plows provided with adjustable squeegees to scrape settled sludge to hopper area near center of the tank.
6. Neoprene squeegees:
  - a. Project squeegees 1 ½ inches below blades.
  - b. Squeegees shall have a minimum thickness of ¼ inches.
  - c. Squeegees shall have 1 inch slots to allow 1 inch vertical adjustment downward to account for wear.
7. Design truss arm to transmit all torques (including test torque and stall torque of 130% of the AGMA rated running torque) to the center cage without over stressing members.
8. Truss arm shall be fabricated to parallel the bottom of tank.

## 2.5 CONTROLS

- A. Overload Monitoring and Protection System:
  1. Furnish an electrical-mechanical overload control system for each clarifier drive mechanism. The overload system shall be actuated by the movement of the worm shaft in the intermediate wormgear speed reducer.
  2. Provide normally open contacts which close at 80% of the design running torque for alarm activation.
  3. Provide normally closed contacts which open at 100% of the design running torque for motor shutdown.
  4. Provide visual torque indicating device suitable for outdoor mounting calibrated from 0 to 160% of the design running torque to indicate load during operation.
  5. Alarm and motor cutout loads shall be independently field adjustable, with initial setting to be made by manufacturer.
  6. Overload system enclosure constructed to meet NEMA 4X.
  7. Shear Pins:
    - a. Provide shear pin device set for 140% of AGMA rated torque.
    - b. Provide straight, non-tapered shear pins with bushings.
- B. Clarifier Mechanism Operational Control:
  1. Each clarifier mechanism shall be provided with a control panel that allows control from the center drive mechanism location. The control panel and components shall comply with 26 09 16 - Control Equipment Accessories.
  2. The panel shall contain the following face mounted items:
    - a. Hand-Off-Automatic selector switch for the hopper pump, the suction arm pump, and the drive motor.
      - 1) In Hand, mechanism shall operate unless prevented by overload protection system.
      - 2) In Automatic, a timer shall be provided to stop and start the process. The timer shall be a 24-hour timer allowing 1 to 48 ON-OFF operations per day, with 15 minute switching changes. Timer shall also allow automatic skipping of zero to six chosen days of the week.
    - b. There shall be calibrated timers for control of the pumps and drive motor in automatic mode. Timers shall be adjustable by the Owner without special tools or programming codes. Timers shall be adjustable from at least zero to 180 minutes. Timers shall be visibly time out/count down. Provide and label timers for:
      - 1) Run drive motor zero to 360 minutes
      - 2) Delay start of hopper pump
      - 3) Run hopper pump
      - 4) Delay start of vacuum pump
      - 5) Run hopper pump
    - c. E-stop mushroom-type pushbutton that will stop the mechanism when activated.



- d. Initial alarm high torque overload indicating light.
  - e. Shutdown high torque overload indicating light.
  - f. Run indicating light. Contacts for remote run indication shall also be provided.
  - g. Off indicating light. Contacts for remote off indication shall also be provided.
  - h. Disconnect switch.
  - i. There shall be an external push button with indicator light for manual initiation of automatic operation that overrides the 24-hour timer for the duration of one automatic process defined as the timing out of all timers.
  - j. There shall be an external push button with indicator light for manual initiation of automatic operation that overrides the 24-hour timer for the duration of one automatic process defined as the timing out of all timers.
  - k. A single, N.O. dry contact shall be provided to indicate any of the above alarm conditions. The contact shall be used for tying into a future hatchery control alarm system.
- C. During automatic process, controller shall allow both pumps to run, either pump to run or no pump to run. Controller shall allow drive motor to be run continuously in hand position while pumps remain in automatic.

## **2.6 MAINTENANCE MATERIALS**

- A. Provide the following spare parts:
- 1. One set of all drive unit and bearing seal rings.
  - 2. Two sets of all gaskets.
  - 3. Two sets of spur gear felt seals and replaceable bearing races.
  - 4. Two sets neoprene lip seals.
  - 5. One spare sight glass or oil gauge.
  - 6. Twenty shear pins of each size used.
  - 7. One primary gear reduction unit of each size used.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install clarifier equipment according to manufacturer's recommendations.
- 1. Manufacturer's service technician to observe and direct equipment installation.
  - 2. Manufacturer's service technician to certify that mechanism has been installed in accordance with manufacturer's recommendations.
  - 3. Install grout layer in accordance with manufacturer's recommendations. Clarifier equipment mechanism shall not be used for screeding grout or for checking grout surface without Contractor obtaining specific, written approval of clarifier equipment manufacturer (submit copy to Engineer prior to grouting). When such use is approved by clarifier equipment manufacturer, cover clarifier equipment suction header to prevent grout from entering ports on suction header. Comply with all other manufacturer's written recommendations and written instructions. Regardless of method used for grouting, unless otherwise required elsewhere in the Contract Documents, provide finished grout surface in accordance with Section 03 35 00 - Concrete Finishing and Repair of Surface Defects with smooth, troweled surface finish.

### **3.2 FIELD QUALITY CONTROL**

- A. See Section 01 61 03 - Equipment - Basic Requirements.
- B. General:
- 1. Employ and pay for services of equipment manufacturer's field service representative(s) to:
    - a. Inspect equipment covered by this Specification.
    - b. Supervise adjustments and installation checks.

- c. Provide test equipment, tools, and instruments necessary to accomplish equipment testing.
  - d. Conduct initial startup of equipment, perform operational checks, and supervise acceptance testing.
  - e. Provide through Contractor a written statement certifying that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.
- C. Torque Test:
- 1. Load test the entire collector mechanism by anchoring collector arms individually, one at a time. In successive tests, demonstrate the collection mechanism's (including drive unit, cage, gears and structures) capability to withstand not less than 130% of the specified rated running torque.
  - 2. The clarifier mechanism shall be field torque tested. The testing shall be carried out under the supervision of the equipment manufacturer's representative before the mechanisms are approved and placed into operation.
  - 3. The torque test shall consist of securing the rake arms by cables to anchor bolts installed by the contractor in the tank floor at locations recommended by the manufacturer and acceptable to the Engineer. A torque load shall be applied to the scraper arm by means of a ratchet lever and cylinder connected to the cable assembly.
  - 4. The magnitude of the applied load shall be measured by calculating the torque from the distance of the line of action of each cable to the center line of the mechanism. Readings shall be taken at 100% and 120% of the AGMA rated torque. The test load shall be applied and noted on the torque overload device.
  - 5. The manufacturer's service representative shall certify that the alarm and motor cutout torque of the drives as calibrated in the manufacturer's shop are in proper operation to shut down the units as specified.
- D. Operation Tests:
- 1. Following successful completion of the Torque Tests.
  - 2. Dry Tank Operational Test: Operate the collector mechanism in a dry tank for a minimum of four continuous hours.
    - a. At no time during the test shall the equipment exceed the rated torque or exhibit indications of binding or uneven operation.
    - b. Record torque values as registered on the drive mechanism torque indicator and motor amperage (all three phases) at hourly intervals.
    - c. If the mechanism exceeds rated torque, motor amperages or the mechanism exhibits indications of binding or improper adjustment:
      - 1) Immediately halt the test and remedy the problem.
      - 2) After completion of necessary repairs or adjustments, repeat the tests.
  - 3. Fully Submerged Operational Test: After successful completion of the Dry Tank Operational Test, fill clarifier with water to its operating level and operate mechanism continuously at its maximum speed for 48 hours.
    - a. At no time during the test shall the equipment exceed the rated torque or exhibit indications of binding or uneven operation.
    - b. Record torque values as registered on the drive mechanism torque indicator and motor amperage (all three phases) at 3 hour intervals.
    - c. If the mechanism exceeds rated torque or the mechanism exhibits indications of binding or improper adjustment:
      - 1) Immediately halt the test and remedy the problem.
      - 2) After completion of necessary repairs or adjustments, repeat the tests.
      - 3) Failure to successfully complete the test in three attempts is sufficient cause for rejection and for Owner to require that the equipment be removed from the Project.
  - 4. Skimming System Operation Test:

- a. Following start-up of the clarifier, the Contractor, under the supervision of the manufacturer's representative, shall test and demonstrate the effectiveness of the skimming system to sweep the clarifier surface and remove material.
- b. Owner will observe test and Contractor shall adjust skimming system as required to obtain Owner acceptance.

### **3.3 CLOSEOUT ACTIVITIES**

#### **A. Training**

1. Provide minimum of 8 hours of training of Owner's personnel for all equipment described in this section.

**END OF SECTION**

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## **SECTION 46 71 33**

### **ROTARY DRUM FILTER**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Rotary drum filters with effluent level control pan and with backwash systems with strainers, valves, gages, pumps and hoses.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Division 26 - Electrical.

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. A48, Standard Specification for Gray Iron Castings.
    - b. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
  - 2. American Welding Society (AWS).
  - 3. Hydraulic Institute (HI).
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Single Source Responsibility:
  - 1. All equipment described in this Specification shall be supplied by the filter manufacturer.
  - 2. The filter manufacturer shall be fully responsible for the design of the equipment and integration of all system components to meet all design and performance requirements specified herein.

##### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Specification Section 01 61 03.
  - 3. Utility utilization rates and pressures.
  - 4. Provide complete manufacturer's installation instructions, construction details, materials of construction, electrical diagrams, and motor and drive details.
  - 5. Provide complete layout drawings showing locations of ancillary equipment, foundation requirements and supporting calculations, utility connections, location of thickener relative to equipment pad and discharge end enclosure.
  - 6. Filter specifications including type and mesh size or opening size.
  - 7. Documentation necessary to verify that filter unit complies with specified construction.
  - 8. Performance test protocol.
  - 9. Provide complete layout drawings for discharge end enclosure.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.
- C. Informational Submittals:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. List of past projects of similar scope and size.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS OF DRUM FILTERS AND SUPPLIER OF WHOLE PACKAGE**

- A. Basis of design is NP Innovations represented by Water Management Technologies of Innovasea

### **2.2 ROTATING DRUM FILTER**

A. General

1. The rotating drum filter shall be provided by a manufacturer with the ability to document a minimum of five installations with similar flow rates and loading characteristics.
2. The rotating drum filter manufacturer shall review the installation drawings for the drum filter. If special mounting, sealing, or support items are needed for proper installation the drum filter manufacturer shall provide these items as part of the equipment supplied.

B. Rotating Drum Filter Design and Operation

1. The rotating drum filter shall consist of the drum rotation drive-line, filter elements, drum tank and cover structure, spray bar, sludge trough, support bearings, integral effluent weir and integral bypass weir, liquid level controls and high pressure rinse system.
2. The rotating drum filter shall operate by passing influent solids laden water into the interior of the drum cavity. Influent water shall flow by gravity through the filter elements causing solids to impinge on the interior side of the filter elements. The water level in the drum cavity will rise due to filter occlusion until the liquid level control mechanism (or timer when in timer mode) activates a high pressure rinse bar (by way of backwash pump) to backwash the solids off the filter elements into a sludge trough. Simultaneously, a driveline shall turn the drum exposing all filter elements to the backwash spray. When the water level inside the drum drops back to normal, the liquid level control mechanism shall be disengaged and activate an off delay timer to ensure complete cleaning of elements. The cycle shall repeat itself on demand as the filter becomes loaded. In addition the filter shall be provided with a high level alarm float switch to alarm a condition when the filter is not cleaning adequately. The drum filter shall be provided in a packaged system complete with all controls, sensors, motor starters, pumps, throttling valves and wiring shall be included for installation as shown on the Drawings. The units shall be pre-wired, plumbed, and assembled in the factory to greatest extent possible.
3. The rotating drum filter shall be capable of continuous filtration of water under the conditions outlined in the Rotating Drum Filter schedule in the Drawings.

C. Drum Filter Components

1. Driveline. An industrial duty gearbox shall be coupled to the rotating drum filter shaft by #80 riveted roller chain and sprockets or approved equal. The chain shall run in a continuous oil bath for extended life and corrosion resistance.
2. Filter Element. The filter cloth shall be of the micron rating indicated above and shall be bonded to polyethylene grids measuring. Individual filter elements shall be easily removed without removal or disengagement of addition filter elements. Filter elements shall be sealed to the drum structure utilizing EDPM type gasket material to provide water tight closer.
3. Drum Seal. The drum seal shall provide continuous and positive protection against particles from bypassing the filter elements.
4. Drum Support. The drum shall be supported on the three point bearing system utilizing POM plastic grease fitted roller bearings. The drum shaft shall be constructed of AISI 316SS and bolted to the drum structure.
5. Spray Bar. The rotating drum filter shall have one common spray bar providing multiple nozzles per filter element width to provide overlapping coverage. The nozzles shall be quick release type to allow for easy cleaning, construction with nylon quick release cap and stainless steel spray tip.

6. High Pressure Rinse and Level Control System. The backwash system including all required pumps, piping, level sensors, throttling valves, nozzle protection strainers and controls shall be provided by the filter manufacturer as a package system. Backwash spray system pumps shall draw water through a stainless steel foot valve from the filtered water side of the drum filter, unless shown otherwise on the Drawings. The system shall be capable of supplying water to the drum filter backwash system nozzles at a pressure of 100 psi or greater at the flow required to clean the filters.
  7. Frame, weirs, inlets and outlets shall be 304 stainless steel. The drumfilter shall also have a hinged cover, constructed of 304 stainless steel or aluminum or FRP and designed specifically for the drum filter provided.
  8. Influent weirs shall be included in the package.
  9. Alarms. The rotating drum filter shall be provided with an alarm float switch. The high-level alarm setting shall be adjustable and set initially to activate the alarm if the water rises 2 inches above the level setting that activates the backwash system.
  10. Electric Starting Current. To avoid overloading the generator, motors must be provided with a soft-starter or VFD or stepped onto generator power with an adjustable time delay.
- D. Drum Filter Spare Parts
1. Spare parts shall be delivered in labeled containers suitable for storage at the project site.
  2. Furnish one rubber lip seal, drive motor, gear box, bearings for center shaft and at least 10% of one complete set of filter panels in each mesh size required with at least 10% of one complete set of straps, nuts and bolts. Also for each drum filter, furnish 25% of one complete set of nozzles with nuts and gaskets and one complete set of boogie support wheels with bearings and shafts.
- E. Backwash Pump
1. The pump shall be of the vertical multi-stage design with the motor mounted directly to the pump.
  2. The pump shall have a mechanical seal of tungsten or silicon carbide.
  3. The pump shaft and housing shall be constructed of stainless steel. The motor stool shall be constructed of cast iron. The pump shaft coupling shall be constructed of cast iron.
  4. The pump motor shall be sized to ensure the pump is non-overloading when operating on the specified pump curve. Motor design shall be totally enclosed fan cooled with a NEMA C face design operating at a nominal 3,450 RPM with a minimum service factor of 1.15. Lower motor bearings shall be adequately sized to insure long motor life.
- F. Wye Strainers/Filters for nozzle protection
1. Filters/Strainers shall have 80 – 100 mesh (or 130 micron) stainless steel filter with free area at least three times the area of the inlet pipe. Amiad is one maker of such strainers.
  2. Filter/Strainers shall have a ½ IN or ¾ IN full port “blow-off”/drain connection and stainless or polyethylene ball valve.
  3. Strainers shall have reinforced polyester body and cover that is secured by not more than four fasteners, removable without the use of tools. Units shall be rated to at least 150 psi.
  4. Provide stainless pipe and/or hose and adapters and a full-size bronze globe valve all suitable for 150 psi operating pressure.
- G. Controls
1. Electrical components shall be enclosed in a hinged door, NEMA 4X enclosure, one control panel for each drum assembly. Provide adequate cooling for equipment enclosed for 40 C ambient air.
  2. Provide a control power transformer of sufficient capacity for the control components. Provide two-primary fuses and one secondary fuse. Ground transformer per NEC.
  3. Provide a “hand-off-auto” selector switch for the drum filter drive and a “hand-off-auto” selector switch for the backwash pump.
  4. Provide a three-position “mode of operation” selector switch. The switch is used to select one of three modes of automatic operation; - Float Switch; - 24-hour timer; or - Float Switch and 24-hour timer.

5. Provide controls to set the time clock interval and backwash duration. "Interval" is the time between backwash operations, and "duration" is the minimum amount of time the backwash operates.
6. A float switch shall be factory mounted to sense drum filter influent level and initiate a backwash cycle when that level drops to 8 IN above normal influent level. A 2nd float switch shall be factory mounted to the drum filter to sense influent water level and shall activate a high water level alarm when the emergency overflow level is reached. All float switches shall be adjustable.
7. Each control panel shall include a solid-state "soft-start" and "soft-stop" motor starter with thermal overload relay for control of the backwash pump.
8. Each control panel shall include a "variable frequency drive" or "soft-start" and "soft-stop" motor controller for the drum motor.
9. Include run time meter for each motor. Run time meters shall be 120-volt and not re-settable from the control panel face. Run time meters requiring batteries will not be allowed.
10. The control panel shall include all electrical components required to operate the drum filter including a control power transformer, timing relays and control relays.
11. The control panel shall include terminal blocks for connection of all field wiring. One terminal shall be provided for each control wire and each power lead.
12. Control panels shall include indicating lights for each alarm including low level alarm, high level alarm, drive motor VFD fault, and backwash pump overload. The alarm lights shall remain lit until the alarm is reset from the control panel. A single N.O. common alarm contact (non-flashing) shall be provided for connection to the hatchery alarm system.
13. The controls shall be designed to automatically restart after a power failure.
14. Panel and related equipment shall be shipped loose to allow for remote install by Contractor.

#### H. Drum Filter Electrical

1. The drum filter assembly shall be provided as a complete package with the drive motor, 316 SS magnetic float switches and NEMA 4X stainless steel junction box with wiring terminals for all field wires. One terminal shall be provided for each control wire and for each motor lead.
2. Appropriate lengths of ½ IN, UL listed, flexible non-metallic conduit with watertight connectors shall be provided for connection to the gear motor, backwash pump and float switches.
3. One float switch shall be provided for activation of the backwash cycle and one float switch for high level alarm and one for low level alarm.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Packaged Rotating Drum Filter

1. Contractor shall install the rotating drum filter in strict accordance with the manufacturer's directions, and the drawings. The equipment shall be fully covered and protected at all times during installation and construction.
2. The drum filter manufacturer shall provide (2) 8-hour site visits; (1) at startup and (1) for operations training refresher by factory-trained representative. Three (3) copies of the operations manual shall be provided at the startup and training.

### 3.2 TESTING

- A. After filter equipment has been installed, contractor shall perform an operational test. Contractor shall monitor head loss of the system under rated flow rate. Contractor shall provide all test equipment and labor for test. Any damage resulting from or caused by the test shall be repaired at contractor's expense.

## END OF SECTION



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*The key to success starts with a solid foundation.*  
ENGINEERING | EXPLORATION | EXPERIENCE

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# Geotechnical Report

*Embden SFRS Improvements  
809 Cross Town Road, Embden, Maine*



Mailing: PO Box 515, Gardiner, ME 04345  
Office: 210 Maine Avenue, Farmingdale, ME 04344  
[www.summitgeoeng.com](http://www.summitgeoeng.com)

## Client

HDR, Inc.  
5201 South Sixth Street Road  
Springfield, Illinois 62703-5143

Project #: 23050  
Date: 3/11/2024

March 11, 2024

Summit #23050

Attn: Andrew Gurski  
HDR, Inc.  
5201 South Sixth Street Road  
Springfield, Illinois 62703-5143

Reference: Geotechnical Engineering Services  
Embden SFRS Improvements – 809 Cross Town Road, Embden, Maine

Dear Mr. Gurski;

Summit Geoengineering Services (SGS) has completed the geotechnical investigation for the proposed improvements at the Embden State Fish Rearing Station located at 809 Cross Town Road in Embden, Maine. The scope of services consisted of conducting subsurface explorations at the site and preparing this report summarizing the findings and geotechnical recommendations for the construction of a new chemical building, clarifier, pump building, and sludge tank.

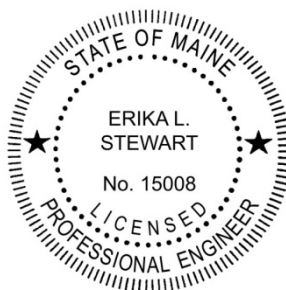
Three test borings were performed at the site; one in the footprint of the proposed chemical dosing building, and two borings around the existing effluent system. Subgrade at the site is comprised of topsoil and fill overlying glacial marine and glacial stream deposits. Refusal on probable bedrock was met in test borings B-1 and B-2 at 17.4 ft below ground surface (BGS). Test boring B-3 was terminated at 26 ft BGS in running sands. Groundwater was observed in the test borings at a depth range of 6.0 to 6.8 feet BGS.

This report provides discussion of the geotechnical findings and design recommendations for the new structures. This geotechnical evaluation is based on the existing site and subsurface conditions, and design plans provided by HDR, Inc. SGS appreciates the opportunity to serve you during this phase of your project. If there are any questions or additional information is required, please do not hesitate to call.

Sincerely yours,  
**Summit Geoengineering Services**



Jason Barnes, E.I.  
Geotechnical Engineer



Erika Stewart, P.E.  
Senior Geotechnical Engineer

## TABLE OF CONTENTS

1.0 Project and Site Description .....	3
2.0 Subsurface Explorations & Laboratory Testing.....	3
2.1 Subsurface Explorations.....	3
2.2 Laboratory Testing.....	3
3.0 Subsurface Conditions.....	4
3.1 Soil Layers .....	4
3.2 Bedrock.....	5
3.3 Groundwater .....	5
4.0 Geotechnical Evaluation.....	5
5.0 Geotechnical Recommendations .....	6
5.1 Spread Footing Foundations .....	6
5.2 Building Slabs.....	7
5.3 Mat Foundations .....	7
5.4 Backfill Recommendations.....	8
5.5 Seismic Analysis .....	9
5.6 Groundwater Control.....	9
6.0 Earthwork Considerations .....	10
7.0 Closure .....	11
Test Boring Location Plan, Surficial Geology Map.....	Appendix A
SGS Boring Logs, S.W. Cole Boring Log (2003).....	Appendix B
Laboratory Test Results.....	Appendix C

## 1.0 Project and Site Description

Summit Geoengineering Services (SGS) was asked by HDR, Inc. to conduct a geotechnical investigation for a new chemical dosing building, sludge pump building, clarifier, and sludge storage tank located at 809 Cross Town Road in Embden, Maine. The site is located east of Cross Town Road and south of Embden Pond at the Embden State Fish Rearing Station. The chemical dosing building is proposed for construction northwest of the existing effluent system. The new clarifier and sludge storage tanks are proposed to replace the existing effluent structure, which is located in the southern portion of the site. The sludge pump building is expected to be constructed between the clarifier and sludge storage tank.

The site is a relatively flat, sloping from downward to from elevation 397 to 396 feet, and dropping off steeply to elevation 387 moving toward Mill Stream. The storage building and pump station are planned as a single-story slab on grade structures with frost wall footings. The new clarifier is expected to consist of an approximate 20-foot diameter cylindrical concrete tank with a mat slab foundation. The sludge storage tank is expected to consist of an approximate 32-foot diameter cylindrical concrete tank with a mat slab foundation. Both the clarifier and sludge storage tank structures are expected to have a cover.

## 2.0 Subsurface Explorations & Laboratory Testing

### 2.1 Subsurface Explorations

SGS observed the subsurface conditions with the drilling of three test borings on September 27, 2023. Test borings B-1, B-2, and B-3 were performed by SGS using a track mount AMS 9580 VTR drill rig. Advancement was performed to a depth of refusal at 17.4 feet BGS in test borings B-1 and B-2. Test boring B-3 was terminated at 26 ft BGS due to running sands. Explorations were performed using 2 ¼-inch hollow stem augers. Standard penetration tests (SPT-N) were conducted at continuous to five-foot intervals using a split spoon sampler and auto-drop hammer. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System (USCS).

The test borings were field located by taping from existing site features and pre-marked prior to drilling for notification of Dig Safe. A site survey located the borings after completion of drilling. A Test Boring Location Plan is included in Appendix A. Logs of the test borings are included in Appendix B. Previous test borings were performed at the site by S.W. Cole in 2003. Relevant borings are shown on the Test Boring Location Plan and logs are included in Appendix B.

### 2.2 Laboratory Testing

Laboratory testing was performed for two samples of glacial stream deposit. The samples were tested for size distribution (ASTM D6913). Results of the laboratory tests are summarized below. Detailed results are attached in Appendix C.

Laboratory Test Results						
Boring	Depth	Gravel	Sand	Fines	Moisture Content	USCS
B-1	10' – 12'	8%	53%	39%	11.0%	SM
B-3	15' – 17'	11%	56%	33%	10.5%	SM

### 3.0 Subsurface Conditions

The subsurface conditions consist of 2 inches of **bituminous pavement** overlying **fill**, overlying **glacial marine deposits** and **glacial stream deposits** in test borings B-1 and B-2. **Topsoil** overlies the glacial marine and glacial stream deposits in test boring B-3. The soil layers are further described below. Details of the explorations are provided in Appendix B.

#### 3.1 Soil Layers

**Topsoil** is present at the ground surface in test boring B-3 with a thickness of approximately 1 foot. The topsoil consists of dark brown sandy silt with rootlets. The topsoil visually classifies as ML in accordance with the Unified Soil Classification System (USCS). The topsoil is considered soft and damp.

A thin layer of former topsoil is present beneath the fill in test boring B-2 from approximately 4 to 5.5 feet BGS. The former topsoil consists of black sandy silt with rootlets and is considered soft and humid. The former topsoil visually classifies as ML in accordance with the USCS.

**Fill** is present beneath the bituminous pavement in test borings B-1 and B-2. The fill consists of a thin layer of brown sand with little to some gravel and trace silt directly beneath the pavement, overlying brown silty sand with some gravel. Based on significant auger resistance observed while drilling, SGS anticipates cobbles and boulders will be present within the fill surrounding the existing structures. The fill is considered compact to dense and humid. The fill classifies as SP and SM in accordance with the USCS.

**Glacial marine deposit** is present beginning at a depth range of 1 to 3 ft BGS and is approximately 9 to 12 ft in thickness. Based on the performed grain size testing, the marine deposit consists of olive brown to gray silty sand with little gravel. Visual descriptions also include silt with sand, and little to trace clay and gravel. The deposit is heavily mottled and is considered stiff or compact, and damp to wet with depth. The deposit visually classifies as ML and SM in accordance with the USCS.

**Glacial stream deposit** is present beneath the glacial marine deposit, beginning at a depth range of 10 to 15 ft BGS. The stream deposit is 2.5 ft thick in test borings B-1 and B-2 and was explored to 26 ft BGS in B-3 with no refusal. Based on grain size distribution testing, the glacial stream deposit

consists of gray silty sand with little gravel and classifies as SM in accordance with the USCS. The glacial stream deposit is considered compact to very dense and wet to saturated.

### 3.2 Bedrock

Refusal on **probable bedrock** was encountered at a depth of 17.4 feet BGS in test borings B-1 and B-2. No refusal was encountered in B-3 to a depth of 26 feet BGS. SGS anticipates the bedrock surface slopes downward moving west towards Mill Stream. Bedrock mapping for the Embden area suggests that the bedrock consist of Fall Brook Formation, which is comprised of thickly bedded metasandstone and metasiltstone.

### 3.3 Groundwater

**Groundwater** was measured at depths of 6.0 to 6.8 ft BGS, approximate elevation 389 to 391 feet, in the test borings. Groundwater is anticipated within the glacial marine deposit and underlying glacial stream deposit. Localized mottling of the marine soils suggest groundwater levels may fluctuate during wet periods such as rainfall or snowmelt.

## 4.0 Geotechnical Evaluation

SGS understands the Embden State Fish Rearing Station improvements will consist of a new chemical and sludge pump building, clarifier, and sludge storage tank. With proper site preparation, the subgrade will be suitable to support the new structures with conventional shallow foundation systems. The new chemical building and sludge storage building are planned as single-story slab on grade buildings with perimeter frost walls. The sludge pump building is expected to be constructed in the footprint of the existing effluent control structure, in the backfill zone between the new clarifier and sludge storage tanks. SGS anticipates pump building finish floor elevation will be at or near existing grade of the adjacent gravel lot; finish floor of the chemical building will be elevated 2 to 3 feet above existing grade. Based on this, footings for the chemical storage building are anticipated to bear on glacial marine sand, and footings for the sludge pump building are anticipated to bear on imported fill.

The clarifier and sludge storage tank are expected to be constructed in the footprint of the existing effluent control system, with piping connected to the sludge pump building. The bottom of the tanks is expected to be at elevation 385 to 386 feet, which is approximately 10 feet below existing grade. The tank foundations are expected to consist of mat slabs. Subgrade for the tanks is expected to consist of glacial marine sand and glacial stream sand. Groundwater is expected to be present within the tank excavations. Based on this, excavations for the new clarifier and sludge storage tanks will require dewatering and may require an excavation support system. The existing effluent control system will be demolished and removed in favor of the new clarifier and sludge storage tank. All foundation elements will need to be removed from beneath new structures.

## 5.0 Geotechnical Recommendations

The following soil parameters can be used for the design of foundation systems:

PARAMETER	STRUCTURAL FILL <sup>1</sup>	GLACIAL MARINE DEPOSIT	GLACIAL STREAM DEPOSIT
Total Natural (moist) Unit Weight ( $\gamma_t$ )	130 pcf	125 pcf	125 pcf
Saturated (buoyant) Unit Weight ( $\gamma_s$ )	68 pcf	63 pcf	63 pcf
Friction Coefficient (f)	0.55	0.45	0.55
Passive Earth Pressure Coefficient ( $K_p$ )	3.54	3.25	3.54
Active Earth Pressure Coefficient ( $K_a$ )	0.28	0.31	0.28
At Rest Pressure Coefficient ( $K_o$ )	0.44	0.47	0.44
Effective Friction Angle ( $\phi'$ )	34°	32°	34°

<sup>1</sup> Based on 95% compaction by ASTM D1557, Modified Proctor Test Method

### 5.1 Spread Footing Foundations

The chemical storage and sludge pump buildings will be supported with perimeter frost walls, bearing on a combination of glacial marine sand and imported fill. SGS recommends using an allowable bearing pressure of 3,000 psf to proportion building footings. Immediate settlement associated with this bearing pressure is estimated at 1 inch or less. Differential settlement is estimated at a deflection of ( $\delta/L$ , deflection divided by span length).

- Topsoil, vegetation, and any deleterious materials are stripped and grubbed from the ground surface within the proposed building footprint prior to proof rolling, placing fill, or constructing footings.
- Former topsoil and organics are over-excavated from beneath footings for the chemical building, extending to the surface of native sand. Subgrade should be stabilized with a minimum of 6 inches of Crushed Stone, placed up to the base of foundations.
- Existing foundation elements are removed in entirety from the footprint of new structures. Any boulders encountered directly beneath new foundations should also be removed. Voids created from this process should be backfilled with Structural Fill placed in compacted lifts up to the base of footings. Material specifications are provided in Section 5.4.



Exterior footings should be constructed at a minimum depth of 5 feet below finished grade for frost protection. This frost protection depth is based on a design air-freezing index of 1,800-degree days for Embden, Maine. SGS recommends exterior and interior portions of foundation elements be backfilled with Structural Fill, as specified in Section 5.4.

### *5.2 Building Slabs*

SGS recommends building slabs be constructed on a minimum 12-inch thick layer of Structural Fill. Topsoil and other deleterious materials should be removed from beneath slabs prior to placing fill. Fill required to raise grade beneath slabs should consist of additional Structural Fill. If unheated, building slabs should be constructed on a minimum 24-inch thick layer of Structural Fill. A layer of 2-inch rigid foam board insulation may be added for additional frost protection.

Granular subgrade above groundwater should be proof-rolled prior to placing fill for the slab. Proof rolling should consist of a minimum of five passes in a north-south direction and then five passes in an east-west direction using a vibratory roller or plate compactor. Proof rolling of saturated or silty subgrade is not recommended due to potential for disturbance.

The coefficient of subgrade reaction,  $k$  (per 12-inch plate) applies to the design of reinforced concrete foundations over soil. For the conditions described above, the slabs can be designed using a coefficient of subgrade reaction 150 tons/ft<sup>3</sup>.

### *5.3 Mat Foundations*

The new clarifier and sludge storage tank will be constructed on structural mat foundations below groundwater. Details on the structures are as follows:

- The clarifier is proposed as a round tank with a diameter of 20 feet. Reinforced concrete walls will be supported on mat slab foundation at an elevation of 386 feet, which is approximately 10 feet below existing grade. The slab will have a thickened center section to facilitate piping.
- The sludge storage tank is proposed as an approximate 32-foot diameter concrete tank. The tank walls will be supported by a reinforced concrete mat sloping down towards a recessed center pit. The top of the slab at the perimeter is expected to be at an elevation of 386 feet.

To create a stabilized base, structural mat foundations should be constructed upon a minimum of 12 inches of Crushed Stone. If subgrade becomes disturbed from groundwater or due to construction, it is recommended the subgrade be inspected by the geotechnical engineer to verify conditions or to recommend further stabilization, if necessary. Foundation walls should be backfilled with Structural Fill. Structural Fill should extend a minimum of 24 inches laterally from the walls.



The coefficient of subgrade reaction  $k_v$  (per 12-inch plate) applies to the design of reinforced concrete foundations over soil. The mat foundations can be designed using a coefficient of subgrade reaction of 150 tons/ft<sup>3</sup>. Bearing soil for the mat slabs is anticipated as medium-compact silty sand. Total settlement is estimated at 1 inch or less for net allowable bearing pressure (to include weight of concrete) of 3,000 psf. Differential settlement is not anticipated for the mat slab foundations due to their rigidity.

SGS anticipates foundation drains will not be practical for mat foundation below groundwater. SGS recommends that mat slabs be designed for uplift forces due to buoyancy. Uplift force of groundwater can be calculated as the unit weight of water multiplied by the depth of foundation below groundwater. For design, a groundwater elevation of 390 feet should be assumed. Associated uplift forces are estimated to range from 250 to 350 psf. The mat slabs should be designed with sufficient ballast weight to provide resistance to uplift during the minimum operating weight of the structures (empty tanks, dead load). Additional uplift resistance can be provided by extending the edge of the mat slab beyond the outside foundation wall to achieve soil resistance. Alternatively, tie downs such as helical soil anchors can be considered.

#### *5.4 Backfill Recommendations*

Structural Fill is recommended for construction of building slabs and backfill of foundation walls. Structural Fill should be placed in maximum of 12-inch lifts and be compacted to 95 percent of its maximum dry density in accordance with ASTM D1557. Structural Fill should consist of well graded sand and gravel with a maximum particle size limited to 6 inches. The portion passing a 3-inch sieve should meet the following:

STRUCTURAL FILL	
Sieve Size	Percent Passing
½ inch	35 to 80
¼ inch	25 to 65
No. 40	0 to 30
No. 200	0 to 7

**Reference:** MDOT Specification 703.06, Type D (2020)

Crushed Stone is intended to create a stable base beneath mat slab foundations and for subgrade stabilization of footings as necessary. Crushed Stone should be tamped to lock the stone structure together and meet the following specification:

CRUSHED STONE ¾ INCH	
Sieve Size	Percent Finer
1 inch	100
¾ inch	90 to 100
½ inch	20 to 55
⅜ inch	0 to 15
No. 4	0 to 5

**Reference:** MDOT Specification 703.13, Crushed Stone ¾-Inch (2020)

### 5.5 Seismic Analysis

The soils at the site are categorized as Site Class D in accordance with ASCE 7-10 based on SPT-N values for the soil profile. Soils at the site are not considered susceptible to widespread liquefaction during earthquakes. The following site seismic site coefficients should be used:

SUBGRADE SITE SEISMIC DESIGN COEFFICIENTS (ASCE 7-10)	
Seismic Coefficient	Site Class D
MCE <sub>G</sub> peak ground acceleration (PGA)	0.107
Site modified peak ground acceleration (PGA <sub>M</sub> )	0.170
Short period spectral response (S <sub>S</sub> )	0.216
1 second spectral response (S <sub>1</sub> )	0.081
Maximum short period spectral response (S <sub>MS</sub> )	0.345
Maximum 1 second spectral response (S <sub>M1</sub> )	0.194
Design short period spectral response (S <sub>DS</sub> )	0.230
Design 1 second spectral response (S <sub>D1</sub> )	0.130

### 5.6 Groundwater Control

Groundwater was observed at a depth range of 6.0 to 6.8 ft BGS. Depending on depth of footings, groundwater may be present near the base of footings for the chemical storage building and sludge pump building. It is generally good practice to install perimeter underdrains at the base of exterior footings to prevent accumulation of water adjacent to foundations. Due to the potential for groundwater fluctuation at the site, SGS recommends underdrains be considered. At a minimum, exterior grades should slope away from the building footprint to reduce water runoff from infiltrating the foundation backfill soils.

If used, perimeter underdrains should consist of 4-inch rigid perforated PVC placed adjacent to the exterior footings and surrounded by a minimum of 6 inches of crushed stone wrapped in filter fabric to prevent clogging from the migration of the fine soil particles in the foundation backfill soils. The underdrain pipe should be outlet to a location where it will be free flowing. Where exposed at the ground surface, the ends of pipes should be screened or otherwise protected from entry and nesting of wildlife, which could cause clogging.

Structures constructed below groundwater should be designed for buoyant conditions and protected from groundwater with a waterproofing system. Resistance to uplift forces from groundwater is discussed in Section 5.3.

## 6.0 Earthwork Considerations

Topsoil, existing foundation elements, and deleterious materials should be removed from the footprint of new foundations and slabs prior to placing fill. This is expected to require some over-excavation. Structural Fill should be placed in maximum 12-inch lifts and compacted to a minimum of 95 percent of its maximum dry density, determined in accordance with ASTM D1557, Modified Proctor Density. Crushed Stone should be tamped into place.

Granular subgrade above groundwater should be proof-rolled prior to placement of engineered fill. This condition generally applies beneath slabs near existing ground surface. Proof rolling should consist of a minimum of five passes in a north-south direction and then five passes in an east-west direction using a vibratory roller. Proof-rolling is not recommended where excavations are located near or below groundwater. SGS recommends a 6-inch minimum layer of Crushed Stone be placed beneath chemical building footings for stabilization. A 12-inch layer of Crushed Stone is recommended beneath mat slabs.

Depending on the depth of footing excavations, groundwater may be present during footing excavations for the chemical storage and sludge pump buildings and will be present during the construction of the clarifier and sludge storage tank. Dewatering will be required for excavations extending below groundwater. SGS recommends that groundwater be controlled to a minimum of 2 feet below the base of excavations. Depending on excavation depths in sand, this may consist of submersible pumps. For deeper excavations, well points may be required within the sand to draw water down. Dewatering should be performed sufficiently to prevent potential upheave at the base of deep excavations. Diversion and control of surface water should be performed to prevent water flow into the excavations. The contractor should furnish, install, operate, maintain, and remove temporary dewatering systems to control groundwater and permit construction free from standing water.

Utility trenching and general excavations below 4 feet should be sloped no greater than 1.5H to 1V (OSHA type C) for granular soils and/or below groundwater. These slopes are based on the current OSHA Excavation Guidelines. Temporary excavation support may be required in excavations where these slopes cannot be met, such as the clarifier and sludge storage tank excavations.

It is recommended that SGS be retained to conduct a subgrade inspection to confirm that soil conditions and construction methods are consistent with this report. SGS further recommends that a qualified material testing consultant be retained to monitor and test soil used during construction to ensure proper material type and placement. Soil materials testing reports should be made available to SGS for review.

## 7.0 Closure

The recommendations provided in this report are based on professional judgment and generally accepted principles of geotechnical engineering and project information provided by others. No other warranty is expressed or implied. Our evaluations and recommendations are based on discrete and widely spaced data points. Some changes in subsurface conditions from those presented in this report are anticipated to occur. Should these conditions differ materially from those described in this report, SGS should be notified so that we can re-evaluate our recommendations.

It is recommended that this report be made available to contractors for informational purposes and be incorporated in the construction Contract Documents. SGS should be retained to review final construction documents relevant to the recommendations in this report. SGS appreciates the opportunity to serve you during this phase of your project. If there are any questions or additional information is required, please do not hesitate to call.

**APPENDIX A**  
TEST BORING LOCATION PLAN  
SURFICIAL GEOLOGY MAP

# PLAN REFERENCE

BASE PLAN - "EXISTING CONDITIONS SURVEY AT EMBDEN STATE FISH REARING STATION", DATED OCTOBER 30, 2023, PREPARED BY OWN HASKELL, INC.

"GENERAL SITE PLAN, EFFLUENT CHARACTERISTIC DESIGNS AT EMBDEN REARING STATION", UNDATED (PRELIMINARY), PREPARED BY HDR.

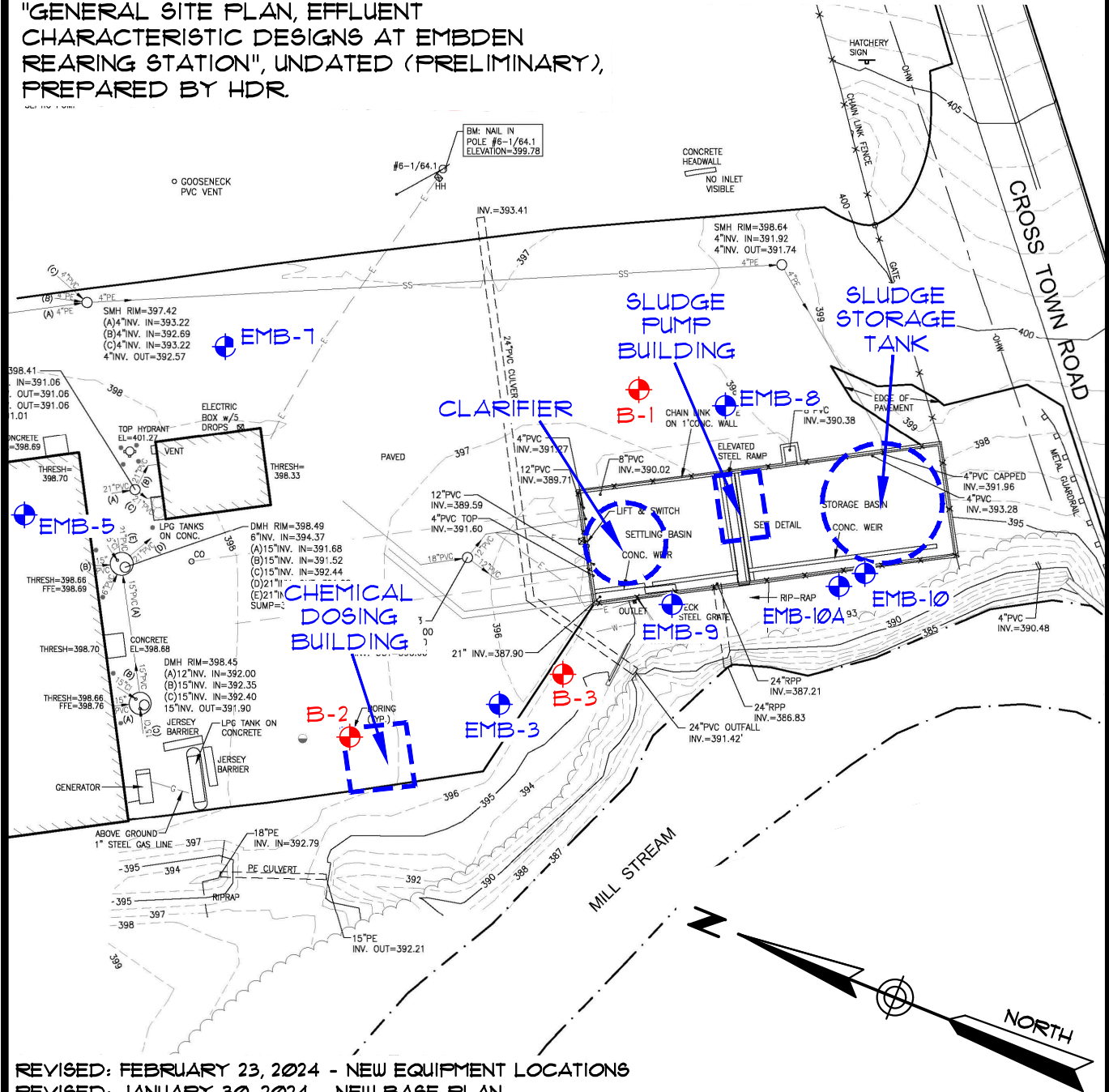
# LEGEND



**B-1** SUMMIT TEST BORING (SEPTEMBER 27, 2023)



**EMB-3** SW COLE TEST BORING (JULY 2003)



REVISED: FEBRUARY 23, 2024 - NEW EQUIPMENT LOCATIONS  
REVISED: JANUARY 30, 2024 - NEW BASE PLAN

## TEST BORING LOCATION PLAN EMBDEN SFRS IMPROVEMENTS

803 CROSS TOWN ROAD - EMBDEN, MAINE  
PREPARED FOR  
HDR, INC.

OFFICE: 210 MAINE AVENUE  
FARMINGDALE, MAINE  
TEL.: (207) 446-3360

MAIL: P.O. BOX 515  
GARDINER, ME 04345

**SUMMIT**  
GEOENGINEERING SERVICES  
www.summitgeoeng.com

DATE: 10-10-2023	DRAWN BY: KRF	CHECKED BY: JNB
JOB: 23050	SCALE: 1" = 40'	FILE: 23050 BOR

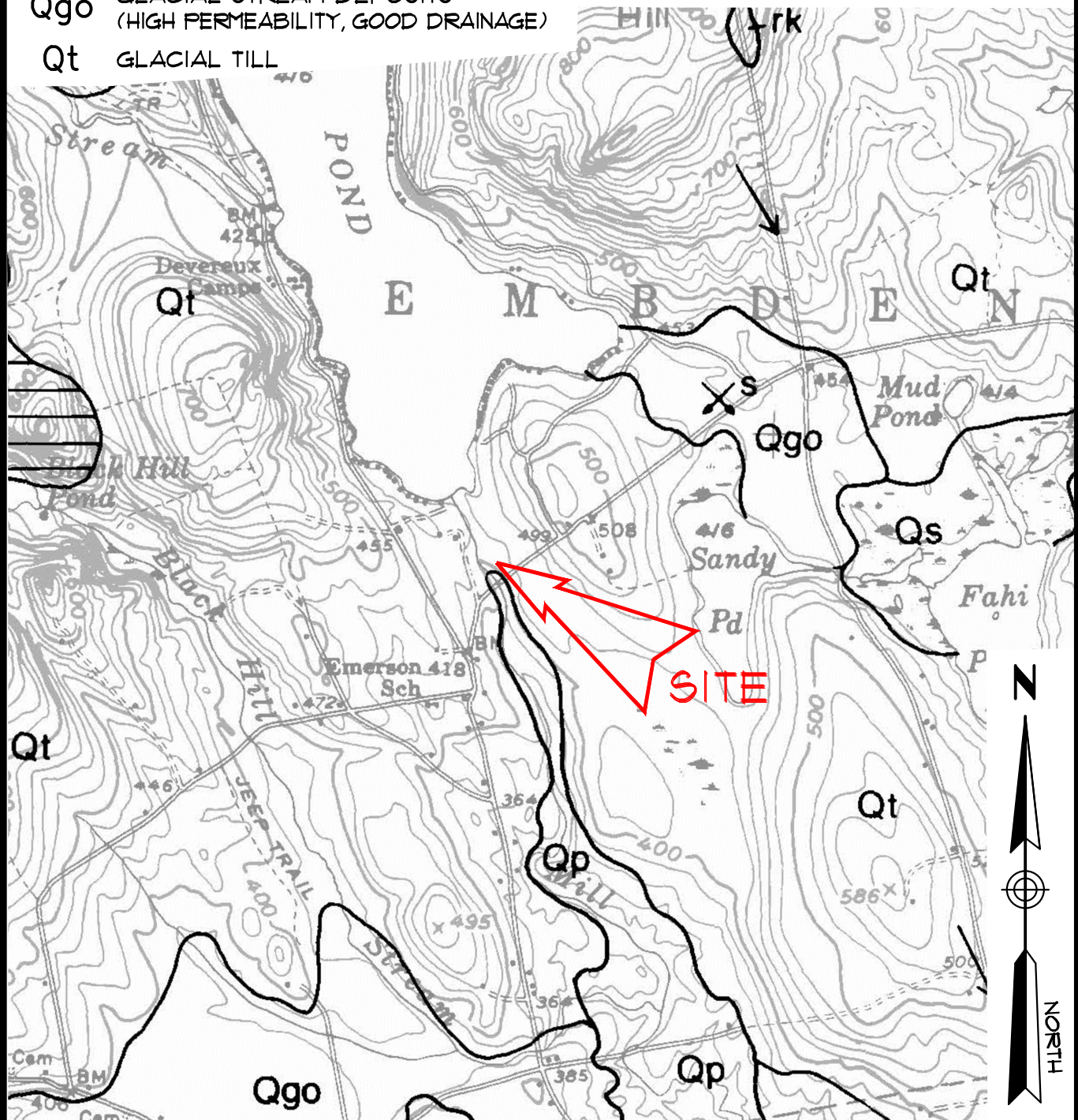


## LEGEND

- Qp PRESUMPSCOT FORMATION  
(SILT, CLAY AND SAND)
- Qgo GLACIAL STREAM DEPOSITS  
(HIGH PERMEABILITY, GOOD DRAINAGE)
- Qt GLACIAL TILL

## PLAN REFERENCE

SURFICIAL GEOLOGY, ANSON  
QUADRANGLE, DATED 1986, PREPARED  
BY MAINE GEOLOGICAL SURVEY.



### SURFICIAL GEOLOGY MAP EMBDEN SFRS IMPROVEMENTS

803 CROSS TOWN ROAD - EMBDEN, MAINE  
PREPARED FOR  
HDR, INC.

OFFICE: 210 MAINE AVENUE  
FARMINGDALE, MAINE  
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MAIL: P.O. BOX 515  
GARDINER, ME 04345

**SUMMIT**  
GEOENGINEERING SERVICES  
[www.summitgeoeng.com](http://www.summitgeoeng.com)

DATE: 10-13-2023	DRAWN BY: KRF	CHECKED BY: JNB
JOB: 23050	SCALE: 1" = 3000'	FILE: 23050 BOR

**APPENDIX B**  
SGS BORING LOGS  
S.W. COLE BORING LOGS (2003)



## EXPLORATION COVER SHEET

The exploration logs are prepared by the geotechnical engineer from both field and laboratory data. Soil descriptions are based upon the Unified Soil Classification System (USCS) per ASTM D2487 and/or ASTM D2488 as applicable. Supplemental descriptive terms for estimated particle percentage, color, density, moisture condition, and bedrock may also be included to further describe conditions.

### Drilling and Sampling Symbols:

S = Split Spoon Sample	Hyd = Hydraulic Advancement of Drilling Rods
UT = Thin Wall Shelby Tube	Push = Direct Push of Drilling Rods
SSA = Solid Stem Auger	WOH = Weight of Hammer
HSA = Hollow Stem Auger	WOR = Weight of Rod
RW = Rotary Wash	PI = Plasticity Index
SV = Lab Shear Vane (Torvane)	LL = Liquid Limit
PP = Pocket Penetrometer	MC = Natural Moisture Content
C = Rock Core Sample	USCS = Unified Soil Classification System
FV = Field Vane Shear Test	Su = Undrained Shear Strength
SP = Concrete Punch Sample	Su(r) = Remolded Shear Strength

### Water Level Measurements:

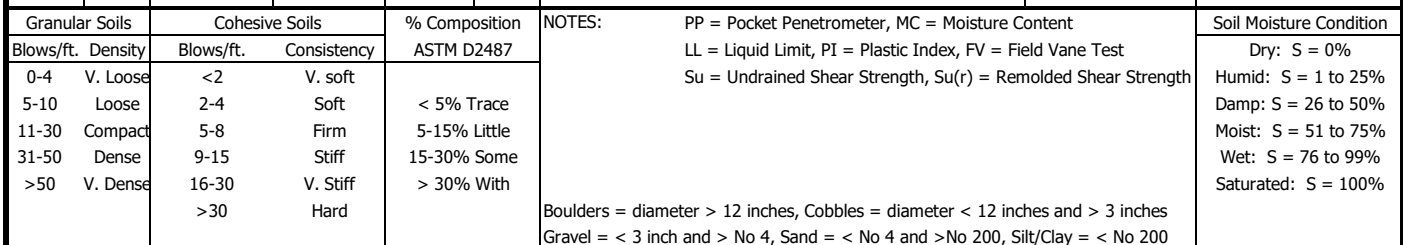
Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations. Groundwater monitoring wells may be required to record accurate depths and fluctuation.

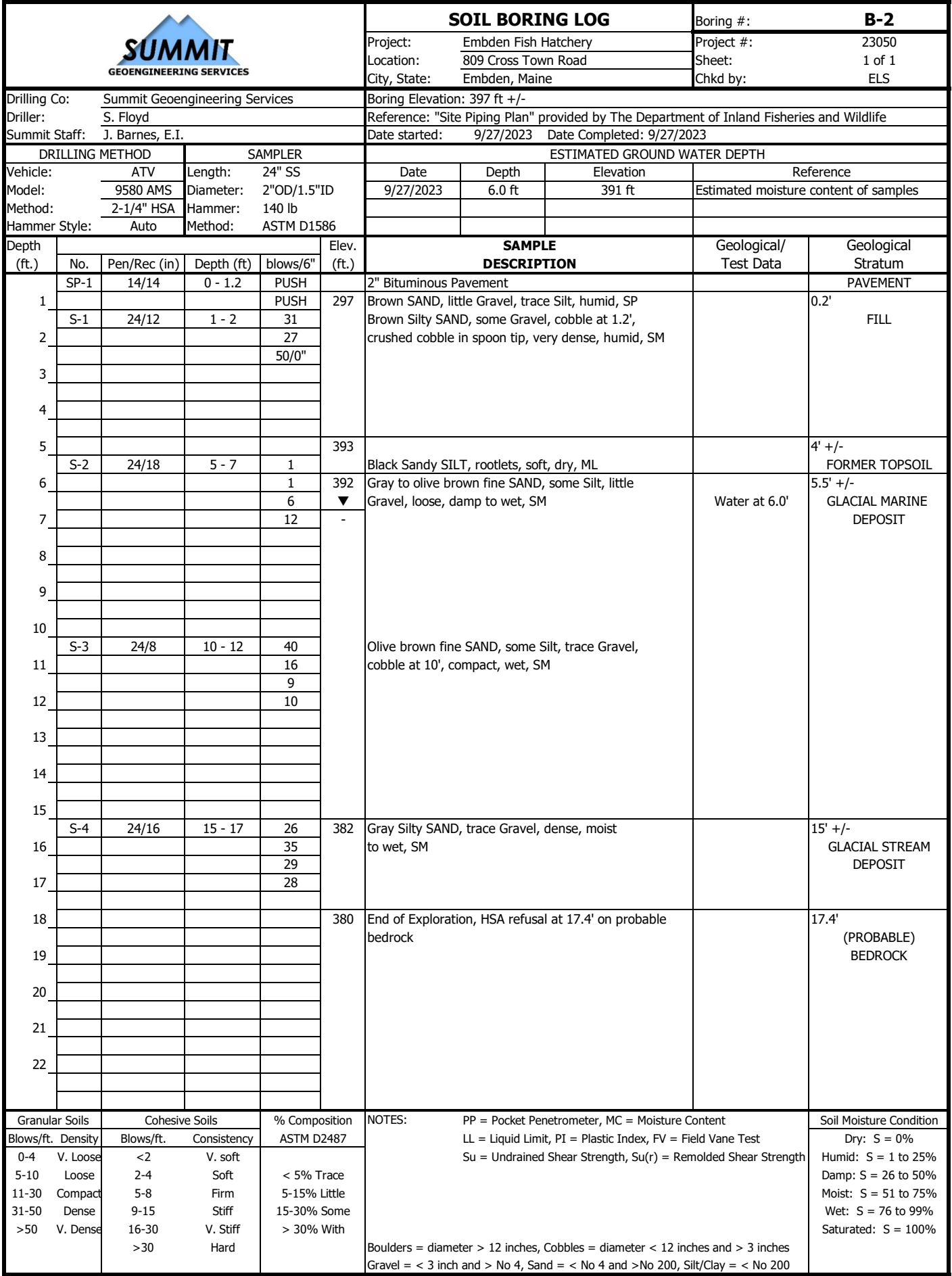
### Gradation Description and Terminology:

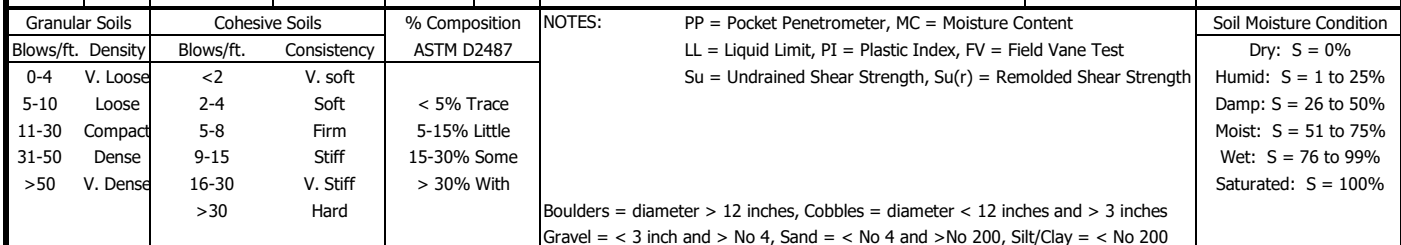
Boulders:	Over 12 inches	Trace:	Less than 5%
Cobbles:	12 inches to 3 inches	Little:	5% to 15%
Gravel:	3 inches to No.4 sieve	Some:	15% to 30%
Sand:	No.4 to No. 200 sieve	Silty, Sandy, etc.:	Greater than 30%
Silt:	No. 200 sieve to 0.005 mm		
Clay:	less than 0.005 mm		


### Density of Granular Soils and Consistency of Cohesive Soils:

CONSISTENCY OF COHESIVE SOILS		DENSITY OF GRANULAR SOILS	
SPT N-value blows/ft	Consistency	SPT N-value blows/ft	Relative Density
0 to 2	Very Soft	0 to 4	Very Loose
2 to 4	Soft	5 to 10	Loose
5 to 8	Firm	11 to 30	Compact
9 to 15	Stiff	31 to 50	Dense
16 to 30	Very Stiff	>50	Very Dense
>30	Hard		







					<b>SOIL BORING LOG</b>			Boring #: <b>B-3</b>		
					Project: Embden Fish Hatchery			Project #: 23050		
					Location: 809 Cross Town Road			Sheet: 2 of 2		
					City, State: Embden, Maine			Chkd by: ELS		
Drilling Co: Summit Geoengineering Services					Boring Elevation: 396 ft +/-					
Driller: S. Floyd					Reference: "Site Piping Plan" provided by The Department of Inland Fisheries and Wildlife					
Summit Staff: J. Barnes, E.I.					Date started: 9/27/2023 Date Completed: 9/27/2023					
DRILLING METHOD		SAMPLER			ESTIMATED GROUND WATER DEPTH					
Vehicle: ATV		Length: 24" SS			Date	Depth	Elevation	Reference		
Model: 9580 AMS		Diameter: 2"OD/1.5"ID			9/27/2023	6.8 ft	389.2 ft	Estimated moisture content of samples		
Method: 2-1/4" HSA		Hammer: 140 lb								
Hammer Style: Auto		Method: ASTM D1586								
Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	Elev. (ft.)	<b>SAMPLE DESCRIPTION</b>		Geological/ Test Data	Geological Stratum	
23						Gray fine SAND, little Silt and Gravel, very dense, wet, SM			GLACIAL STREAM DEPOSIT	
24										
25										
26	S-6	12/6	25 - 25.5	29						
26				50/6"		End of Exploration at 26', Running Sands			26'	
27					370					
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										
38										
39										
40										
41										
42										
43										
44										
Granular Soils		Cohesive Soils		% Composition ASTM D2487	NOTES: PP = Pocket Penetrometer, MC = Moisture Content LL = Liquid Limit, PI = Plastic Index, FV = Field Vane Test Su = Undrained Shear Strength, Su(r) = Remolded Shear Strength  Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches Gravel = < 3 inch and > No 4, Sand = < No 4 and >No 200, Silt/Clay = < No 200					Soil Moisture Condition
Blows/ft.	Density	Blows/ft.	Consistency							Dry: S = 0% Humid: S = 1 to 25% Damp: S = 26 to 50% Moist: S = 51 to 75% Wet: S = 76 to 99% Saturated: S = 100%
0-4	V. Loose	<2	V. soft	< 5% Trace						
5-10	Loose	2-4	Soft	5-15% Little						
11-30	Compact	5-8	Firm	15-30% Some						
31-50	Dense	9-15	Stiff	> 30% With						
>50	V. Dense	16-30	V. Stiff							
		>30	Hard							







[illegible][illegible][illegible]

SEAL: 



STATE OF MAINE  
DEPARTMENT OF INLAND  
FISHERIES AND WILDLIFE

DRAWING TITLE:	BORING LOGS B-7 to B-10A
PROJECT:	EMBDEN STATE FISH HATCHERY RENOVATION PROJECT MAINE BOND BILL IMPROVEMENTS



**APPENDIX C**  
LABORATORY TEST RESULTS





## GRAIN SIZE ANALYSIS - ASTM D6913

PROJECT NAME: Embden SFRS Improvements  
 PROJECT LOCATION: 809 Cross Town Road, Embden, Maine  
 CLIENT: HDR, Inc.  
 TECHNICIAN: Jason Barnes, E.I.  
 SOIL DESCRIPTION: Silty medium-fine SAND, little Gravel, SM

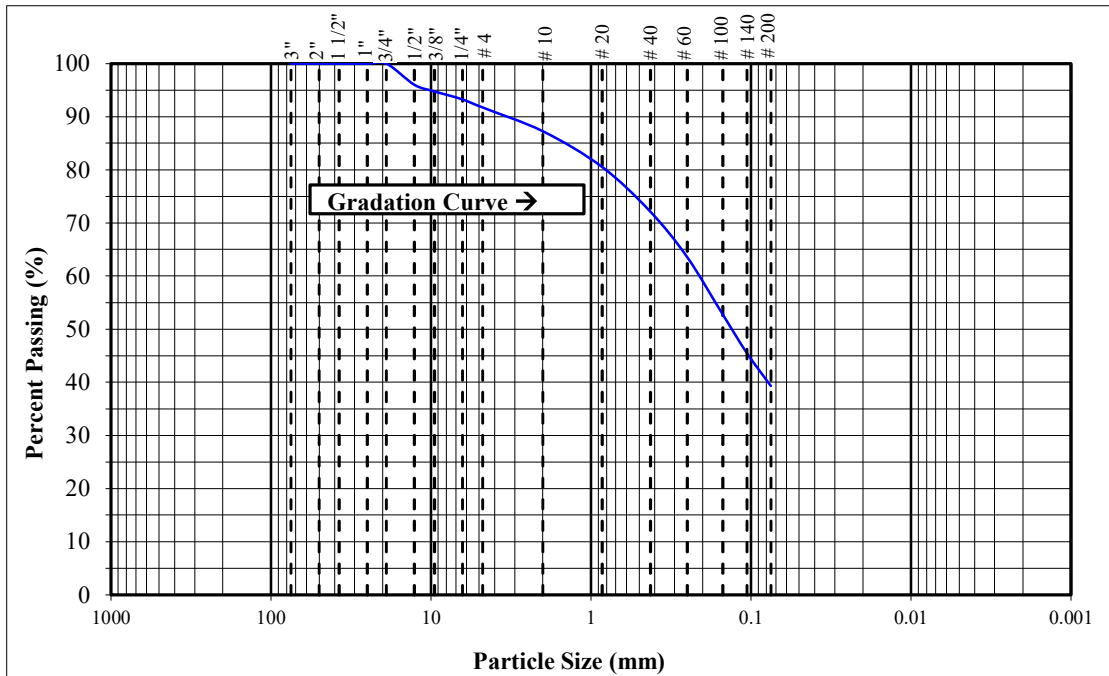
PROJECT #: 23050  
 EXPLORATION #: B-1  
 SAMPLE #: S-3  
 SAMPLE DEPTH: 10' - 12'  
 TEST DATE: 10/16/2023

### TEST PROCEDURE

<b>Sample Source:</b> Split Spoon	<b>Sieve Stack:</b> Composite	<b>Specimen Procedure:</b> Air Dry
<b>Test Method:</b> Method A	<b>Separating Sieve(s):</b> 3/8 Inch	<b>Dispersion Type:</b> Tap Water

### DATA

<u>STANDARD SIEVE</u> <u>DESIGNATION (mm)</u>	<u>ALTERNATIVE SIEVE</u> <u>DESIGNATION (in)</u>	<u>PERCENT</u> <u>PASSING</u> <u>(%)</u>
75	(3 in)	100
50	(2 in)	100
37.5	(1-1/2 in)	100
25.0	(1 in)	100
19.0	(3/4 in)	100
12.7	(1/2 in)	96
9.5	(3/8 in)	95
6.35	(1/4 in)	93
4.75	(No. 4)	92
2.00	(No. 10)	87
0.850	(No. 20)	81
0.425	(No. 40)	72
0.250	(No. 60)	64
0.150	(No. 100)	53
0.106	(No. 140)	46
0.075	(No. 200)	39



REMARKS: Moisture Content = 11%

Reviewed By: CRS

Mailing: PO Box 515, Gardiner, ME 04345  
 Office: 210 Maine Avenue, Farmingdale, ME 04344



## GRAIN SIZE ANALYSIS - ASTM D6913

PROJECT NAME: Embden SFH Improvements  
 PROJECT LOCATION: 809 Cross Town Road, Embden, Maine  
 CLIENT: HDR, Inc.  
 TECHNICIAN: Jason Barnes, E.I.  
 SOIL DESCRIPTION: Silty medium-fine SAND, little Gravel, SM

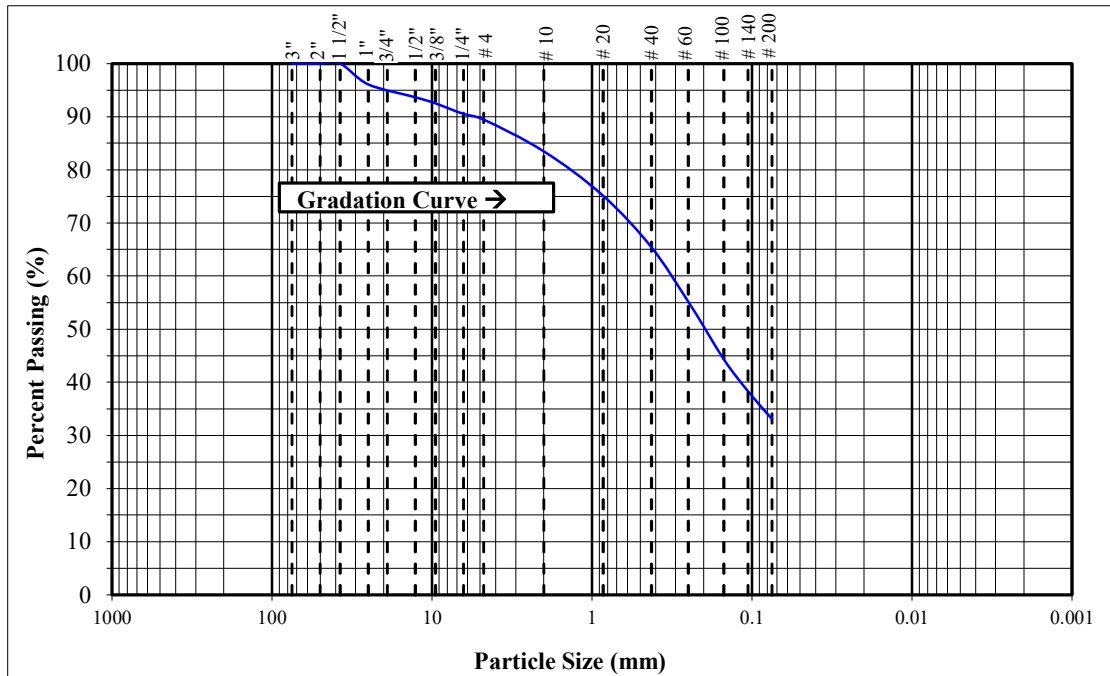
PROJECT #: 23050  
 EXPLORATION #: B-3  
 SAMPLE #: S-4  
 SAMPLE DEPTH: 15' - 17'  
 TEST DATE: 10/16/2023

### TEST PROCEDURE

<b>Sample Source:</b> Split Spoon	<b>Sieve Stack:</b> Composite	<b>Specimen Procedure:</b> Air Dry
<b>Test Method:</b> Method A	<b>Separating Sieve(s):</b> 3/8 Inch	<b>Dispersion Type:</b> Tap Water

### DATA

<u>STANDARD SIEVE</u> <u>DESIGNATION (mm)</u>	<u>ALTERNATIVE SIEVE</u> <u>DESIGNATION (in)</u>	<u>PERCENT</u> <u>PASSING</u> <u>(%)</u>
75	(3 in)	100
50	(2 in)	100
37.5	(1-1/2 in)	100
25.0	(1 in)	96
19.0	(3/4 in)	96
12.7	(1/2 in)	94
9.5	(3/8 in)	93
6.35	(1/4 in)	91
4.75	(No. 4)	89
2.00	(No. 10)	83
0.850	(No. 20)	75
0.425	(No. 40)	65
0.250	(No. 60)	55
0.150	(No. 100)	44
0.106	(No. 140)	38
0.075	(No. 200)	33



REMARKS: Moisture Content = 10.5%

Reviewed By: CRS

Mailing: PO Box 515, Gardiner, ME 04345  
 Office: 210 Maine Avenue, Farmingdale, ME 04344