38

**September 18, 2020 Letting**

# Notice to Bidders, Specifications and Proposal


**Contract No. 62B65**
**LAKE County**
**Section (21&21S)-I**
**Route FAP 346**
**District 1 Construction Funds**

Prepared by

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Checked by

(Printed by authority of the State of Illinois)

Illinois Department of Transportation

# NOTICE TO BIDDERS

1. **TIME AND PLACE OF OPENING BIDS.** Electronic bids are to be submitted to the electronic bidding system (iCX-Integrated Contractors Exchange). All bids must be submitted to the iCX system prior to 12:00 p.m. September 18, 2020 prevailing time at which time the bids will be publicly opened from the iCX SecureVault.

2. **DESCRIPTION OF WORK**. The proposed improvement is identified and advertised for bids in the Invitation for Bids as:

   **Contract No. 62B65**
   **LAKE County**
   **Section (21&21S)-I**
   **Route FAP 346**
   **District 1 Construction Funds**

**US 41 @ Deerpath Rd-PS#38. New pump station 38 in the SW quadrant of Deerpath Rd. @ Ahwahnee Ln., decommissioning existing pump station at bridge abutement (SN 049-0033). 2 detention ponds in Lake Forest golf course, 2 new ret. walls, resurfacing, drainage repairs (0.49 miles)**

3. **INSTRUCTIONS TO BIDDERS**. (a) This Notice, the invitation for bids, proposal and letter of award shall, together with all other documents in accordance with Article 101.09 of the Standard Specifications for Road and Bridge Construction, become part of the contract. Bidders are cautioned to read and examine carefully all documents, to make all required inspections, and to inquire or seek explanation of the same prior to submission of a bid.

   (b) State law, and, if the work is to be paid wholly or in part with Federal-aid funds, Federal law requires the bidder to make various certifications as a part of the proposal and contract. By execution and submission of the proposal, the bidder makes the certification contained therein. A false or fraudulent certification shall, in addition to all other remedies provided by law, be a breach of contract and may result in termination of the contract.

4. **AWARD CRITERIA AND REJECTION OF BIDS**. This contract will be awarded to the lowest responsive and responsible bidder considering conformity with the terms and conditions established by the Department in the rules, Invitation for Bids and contract documents. The issuance of plans and proposal forms for bidding based upon a prequalification rating shall not be the sole determinant of responsibility. The Department reserves the right to determine responsibility at the time of award, to reject any or all proposals, to readvertise the proposed improvement, and to waive technicalities.

By Order of the
Illinois Department of Transportation

Omer Osman,
Acting Secretary

# INDEX
# FOR
# SUPPLEMENTAL SPECIFICATIONS
# AND RECURRING SPECIAL PROVISIONS

Adopted January 1, 2020

This index contains a listing of SUPPLEMENTAL SPECIFICATIONS and frequently used RECURRING SPECIAL PROVISIONS.



## SUPPLEMENTAL SPECIFICATIONS

RECURRING SPECIAL PROVISIONS

The following RECURRING SPECIAL PROVISIONS indicated by an "X" are applicable to this contract and are included by reference:

# TABLE OF CONTENTS

**STATE OF ILLINOIS**

# SPECIAL PROVISIONS

The following Special Provisions supplement the "Standard Specifications for Road and Bridge Construction," adopted April 1, 2016 (hereinafter referred to as the Standard Specifications); the latest edition of the "Illinois Manual on Uniform Traffic Control Devices for Streets and Highways" in effect on the date of invitation for bids; the “Manual of Test Procedures for Materials” in effect on the date of invitation for bids; and the "Supplemental Specifications and Recurring Special Provisions" indicated on the Check Sheet included herein which apply to and govern the construction of the Pump Station 38 Relocation, Job No. C-91-086-16, in Lake County, and in case of conflict with any part or parts of said specifications, the said Special Provisions shall take precedence and shall govern.

FAP 346 (US 41) at Deerpath Road
Section (21&21S)-I
Job No. C-91-086-16
Contract 62B65

Pump Station 38, Drainage Retaining Wall & Utility Adjustments
Lake County

## LOCATION OF PROJECT

The existing pump station is located in the south abutment of the US 41 bridge over Deerpath Road in the City of Lake Forest in Lake County, Illinois. The new pump station location is on the southwest corner of Ahwahnee Lane and Deerpath Road. Miscellaneous storm sewer and roadway improvements will be made along Deerpath Road from 100 feet west of Westmoreland Road to 365 feet west of Golf Lane. Additionally, storm sewer, retaining wall, and detention pond grading will occur on the Deerpath Golf Course property north of Deerpath Road. Storm sewer and related drainage work will also be constructed across and along the entrance and exit ramps and mainline US 41 to a point approximately 275 feet north of Deerpath Road. Additional drainage work will be constructed along the exit ramp on the south side of Deerpath Road to a point approximately 165 feet south of Deerpath Road. The gross and net length of the project is 2,934 feet or 0.56 miles.

**DESCRIPTION OF PROJECT**

The improvement consists of the decommissioning of existing Pump Station 38 and construction of a new Pump Station 38 in a different location and associated storm sewer and roadway replacement work, including but not limited to, concrete work, reinforcement bars, glass block and masonry work, doors and frame, roofing, sheet metal work, and site work which includes grading, sidewalk, driveway, and bike path relocation. In addition, the pump station shall include mechanical work consisting of pumps including motors, heating and ventilating equipment, piping for pump, electrical distribution, control, instrumentation, intrusion and fire alarm, lighting, equipment, conduit and wiring, electrical service connection, a natural gas back-up generator within a detached generator building, and Supervisory Control and Data Acquisition (SCADA) System. The offsite infrastructure work supporting the functioning of the new pump station includes storm sewer installation, a jack and bore operation under an active railroad, an access controlled highway, and two access ramps, detention pond construction, retaining walls, sidewalk replacement, roadway resurfacing and minimal pavement widening.

**STAGING AND SEQUENCE OF CONSTRUCTION**

Construction Staging: The Contractor shall be responsible for and include all work for implementing and staging construction in a manner that permits the continuous pumping capabilities throughout the contract period. Suggested Construction Sequencing is provided in the Contract Documents, however, the Contractor is responsible for staging in order to provide the District One Maintenance Contractor vehicular access, pedestrian access and parking adjacent to the existing pump station until such time as it can be decommissioned. The Contractor shall confine his construction operations within the limits of work indicated on the Drawings.

The detour related to the exit ramp closures at US 41 and Deerpath Road will be allowed only between the months of June and August and shall coincide with the summer break of Deer Path Middle School.

**COMPLETION DATE PLUS WORKING DAYS**
Effective: September 30, 1985 Revised: January 1, 2007

Revise Article 108.05 (b) of the Standard Specifications as follows:

"When a completion date plus working days is specified, the Contractor shall complete all contract items and safely open all roadways to traffic by 11:59 PM on, **December 31, 2022** except as specified herein.

The Contractor will be allowed to complete all clean-up work and punch list items within **10** working days after the completion date for opening the roadway to traffic. Under extenuating circumstances the Engineer may direct that certain items of work, not affecting the safe opening of the roadway to traffic, may be completed within the working days allowed for clean up work and punch list items. Temporary lane closures for this work may be allowed at the discretion of the Engineer.

Article 108.09 or the Special Provision for “Failure to Complete the Work on Time”, if included in this contract, shall apply to both the completion date and the number of working days.

**PRE-BID SITE INSPECTION OF PUMP STATION**

The Existing Pump Station No. 38 site will be open for Contractor’s inspection on October 15, 2020, between 9:00AM and 12:00PM local time. A representative of the State will be on hand during this stated time period. In the event the date or time is not suitable, an alternative inspection date and time can be arranged with IDOT’s Bureau of Traffic Operations/Programs at 847-705-4424.

**PROGRESS SCHEDULE**

Time is of the essence in this Contract. It may be necessary for the Contractor to work longer hours, use additional crews, and work during weekends in order to complete the work within the required time limit. The Contractor shall submit a Critical Path Method (CPM) Progress Schedule for the Engineer's approval before the work can be started.

In the event the Contractor falls more than three (3) days behind the approved progress schedule, the Contractor shall work seven (7) days a week at extended hours in order to meet the specified Completion Date.

The Contractor will not be allowed any extra compensation for working longer hours or using extra shifts; working on weekends or during holidays; working during winter months, etc., to meet the specified Completion Date.

**STATUS OF UTILITIES (D-1)**
Effective: June 1, 2016 Revised: January 1, 2020

Utility companies and/or municipal owners located within the construction limits of this project have provided the following information regarding their facilities and the proposed improvements. The tables below contain a description of specific conflicts to be resolved and/or facilities which will require some action on the part of the Department’s contractor to proceed with work. Each table entry includes an identification of the action necessary and, if applicable, the estimated duration required for the resolution.

**UTILITIES TO BE ADJUSTED**

Conflicts noted below have been identified by following the suggested staging plan included in the contract. The company has been notified of all conflicts and will be required to obtain the necessary permits to complete their work; in some instances, resolution will be a function of the construction staging. The responsible agency must relocate, or complete new installations as noted below; this work has been deemed necessary to be complete for the Department’s contractor to then work in the stage under which the item has been listed.

**Pre-Stage**

| STAGE / LOCATION | TYPE | DESCRIPTION | RESPONSIBLE AGENCY | DURATION OF TIME |
|---|---|---|---|---|
| | | | | |

No conflicts to be resolved.

**Stage 1**

| STAGE / LOCATION | TYPE | DESCRIPTION | RESPONSIBLE AGENCY | DURATION OF TIME |
|---|---|---|---|---|
| Deerpath Road Sta. 48+31, 20' LT | Gas | Existing 8" gas line is in conflict with the proposed storm sewer improvements. | North Shore Gas | Contractor for North Shore Gas to install new gas line.<br><br>45 Days Installation |
| Deerpath Road Sta. 49+69, 21' LT to Sta. 50+31, 21' LT | Gas | Existing 8" gas line is in conflict with the proposed storm sewer improvements. | North Shore Gas | Contractor for North Shore Gas to directionally bore a new gas pipe, with a casing, under the SB and across US 41. Pipe will tie back into the existing main on the east side of the interchange.<br><br>45 Days Installation |
| Deerpath Road Sta. 67+19, 30' LT | Gas | Existing 8" gas line is in conflict with the proposed storm sewer improvements. | North Shore Gas | Contractor for North Shore Gas to install new gas line.<br><br>45 Days Installation |
| Deerpath Road Sta. 68+83, 29' LT | Gas | Existing 8" gas line is in conflict with the proposed storm sewer improvements. | North Shore Gas | Contractor for North Shore Gas to install new gas line.<br><br>45 Days Installation |

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|---|---|---|---|---|
| Deerpath Road Sta. 51+85, 272' LT | Electric - Aerial | Existing power pole conflicts with proposed jacked storm sewer. | ComEd | Contractor for ComEd to install new pole.<br><br>___Days Installation |
| Deerpath Road Sta. 51+56, 8' RT and Sta. 51+72, 8' RT | Fiber Optic - Underground | Existing fiber optic line conflicts with proposed storm sewer improvements. | AT&T Distribution | Contractor for AT&T to install new fiber optic lines.<br><br>___Days |
| Deerpath Road Sta. 55+26, 48' RT | Fiber Optic - Underground | Existing fiber optic line conflicts with proposed storm sewer improvements. | AT&T Distribution | Contractor for AT&T to install new fiber optic lines.<br><br>___Days |
| Deerpath Road Sta. 44+90, 23' RT to Sta. 45+55, 22' RT | Telephone – Underground | Existing underground telephone line conflicts with proposed storm sewer improvements. | AT&T Distribution | Contractor for AT&T to install new underground telephone lines.<br><br>___Days Installation |
| Deerpath Road Sta. 47+85, 26' RT to Sta. 50+50, 20' RT | Telephone – Underground | Existing underground telephone line conflicts with proposed multiple storm sewer improvements. | AT&T Distribution | Contractor for AT&T to install new underground telephone lines.<br><br>___Days Installation |
| Deerpath Road Sta. 51+55, 19' RT to Sta. 51+71, 18' RT | Telephone – Underground | Existing underground telephone line conflicts with proposed storm sewer improvements. | AT&T Distribution | Contractor for AT&T to install new underground telephone lines.<br><br>___Days Installation |
| Deerpath Road Sta. 54+74, 19' RT to Sta. 55+41, 19' RT | Telephone – Underground | Existing underground telephone line conflicts with proposed storm sewer improvements. | AT&T Distribution | Contractor for AT&T to install new underground telephone lines.<br><br>___Days Installation |

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|---|---|---|---|---|
| Deerpath Road Sta. 67+13, 15' RT | Telephone – Underground | Existing underground telephone line conflicts with proposed storm manhole. | AT&T Distribution | Contractor for AT&T to install new underground telephone lines.<br><br>___Days Installation |
| Deerpath Road Sta. 44+90, 23' RT to Sta. 55+41, 19' RT | Telephone – Underground | Existing underground telephone lines conflict with proposed storm sewer improvements. | AT&T Distribution | Contractor for AT&T Distribution to relocate/reinstall underground telephone lines owned/operated by Teleport/AT&T LNS within any ducts relocated by AT&T Distribution.<br><br>___Days Installation |
| Deerpath Road Sta. 44+90, 23' RT to Sta. 55+41, 19' RT | Fiber Optic - Underground | Existing underground telephone lines conflict with proposed storm sewer improvements | AT&T Distribution | Contractor for AT&T Distribution to relocate/reinstall underground fiber optic lines owned/operated by TDS Metrocom within any ducts relocated by AT&T Distribution.<br><br>___Days Installation |

**Stage 2**

| STAGE / LOCATION | TYPE | DESCRIPTION | RESPONSIBLE AGENCY | DURATION OF TIME |
|---|---|---|---|---|
| | | | | |

No conflicts to be resolved.

**Pre-Stage: _____ Days Total Installation**
**Stage 1: _____ Days Total Installation**
**Stage 2: _____ Days Total Installation**

The following contact information is what was used during the preparation of the plans as provided by the Agency/Company responsible for resolution of the conflict.

| Agency/Company Responsible to Resolve Conflict | Name of contact | Phone | E-mail address |
|---|---|---|---|
| **North Shore Gas** (see UTILITIES TO BE WATCHED AND PROTECTED above for additional contact information) | Chris Elvambuena, E.I.T.<br><br>Jay Hammer | (847) 263-4680<br><br>(847) 263-4678 | Noel.Elvambuena@northshoregasdelivery.com<br><br>jay.hammer@northshoregasdelivery.com |
| **City of Lake Forest** | Bernard Pondexter<br><br>Becky Pocasangre | (847) 810-3556<br><br>(847) 810-3543 | pondextb@cityoflakeforest.com<br><br>pocasanb@cityoflakeforest.com |
| **AT&T Distribution (Legal Mandate)** | Hector Garcia<br><br>Darrel Brown | (630) 573-5465<br><br>(630) 573-6496 | hg2929@att.com<br><br>db1324@att.com |
| **Teleport/ AT&T LNS** | Jason Sterenberg<br><br>Jen Wilson | (630) 487-5449 | jsterenberg@cgroupmail.com<br><br>Jw304b@att.com |
| **AT&T Transmission** | Ken Colwell<br><br>Rich Meyers | (312) 734-2223<br><br>(630) 383-9249 | kc1298@att.com |
| **ComEd** | Inam Sharif<br><br>Vincent Mazzaferro, PE | (847) 816-5541<br><br>(779) 231-1027 | http://www.comed.com/newbusiness |
| **Comcast Cable** | Nick Mihalka<br><br>Robert Stoll | (224) 229-4513<br><br>(224) 229-5861 | ROBERT_STOLL2@comcast.com |

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| **Level 3 Communications/ Centurylink** | Kendall Williams-Zetina<br><br>Ben Pacocha | (918) 547-0547<br><br>(847) 954-8250 | Kendall.Zetina@centurylink.com<br><br>Ben.pacocha@level3.com |
| **TDS Metrocom** | Matthew Schulte | (262) 754-3063 | Matt.schulte@tdstelecom.com |
| **MCI / Verizon** | Joe B. Chaney Jr. | (312) 617-2131 | Joe.Chaney@Verizon.com |
| **Sprint** | Steven T. Hughes | (513) 459-5796 | Steven.Hughes1@T-Mobile.com |

**UTILITIES TO BE WATCHED AND PROTECTED**

The areas of concern noted below have been identified by following the suggested staging plan included for the contract. The information provided is not a comprehensive list of all remaining utilities, but those which during coordination were identified as ones which might require the Department's contractor to take into consideration when making the determination of the means and methods that would be required to construct the proposed improvement. In some instances, the contractor will be responsible to notify the owner in advance of the work to take place so necessary staffing on the owner's part can be secured.

The contractor shall notify North Shore Gas seven (7) days in advance of work that will be adjacent to their facilities. Contractor shall contact Chris Elvambuena at (847) 263-4680 and Criss Redmond at (312) 756 – 9796 seven (7) days prior to proposed storm sewer placement to notify them of the proposed work and so they can have a representative present when the proposed storm sewer goes in next to their facilities.

The contractor shall notify Sprint seven (7) days in advance of work that will be adjacent and crossing their facilities. Contractor shall contact Jason Jarvis at (219) 433-4091 seven (7) days prior to the proposed pipe jacking to notify him of the proposed work so they can have a representative present during the test hole to locate the Sprint facilities and for when the proposed pipe jacking operation crossed their facilities.

**Pre-Stage**

| STAGE / LOCATION | TYPE | DESCRIPTION | OWNER |
|---|---|---|---|
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No facilities requiring extra consideration.

**Stage 1**

| STAGE / LOCATION | TYPE | DESCRIPTION | OWNER |
|---|---|---|---|
| Deerpath Road Sta. 47+28, 11' RT | Gas | Existing 8" gas line is to remain. Contractor will be installing a 54" storm sewer main drain across (below) the gas line. Gas line shall be protected from damage by the Contractor during construction of storm sewer improvements. Contractor shall contact Chris Elvambuena at (847) 263-4680, and Criss Redmond at (312) 756 – 9796 seven (7) days prior to proposed storm sewer placement, to ensure that a representative of North Shore Gas Co. will be present when the proposed storm sewer goes in next to their facilities. | North Shore Gas |
| Deerpath Road Sta. 48+62, 49' LT | Gas | Existing 2" gas line is to remain. Contractor will be installing a 54" storm sewer main drain across (below) the gas line. Gas line shall be protected from damage by the Contractor during construction of storm sewer improvements. | North Shore Gas |

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| Deerpath Road Sta. 49+16, 272' LT | Gas | Existing 16" high-pressure gas line is to remain. Contractor will be installing a 43" x 78" storm sewer across (below) the gas line. The Contractor for North Shore Gas to wrap and otherwise protect the pipeline.<br>Gas line shall be protected from damage by the IDOT Contractor during construction of storm sewer improvements. Contractor shall contact Chris Elvambuena at (847) 263-4680, and Criss Redmond at (312) 756 – 9796 seven (7) days prior to proposed storm sewer placement, to ensure that a representative of North Shore Gas Co. will be present when the proposed storm sewer goes in next to their facilities. | North Shore Gas |
| Deerpath Road Sta.46+60, 8' RT | Fiber Optic - Underground | Existing fiber optic lines to remain. Contractor will be installing a 42" storm sewer across the fiber optic lines.<br>Fiber Optic lines shall be protected from damage by the Contractor during construction of storm sewer. | City of Lake Forest |
| Deerpath Road Sta.48+43, 31'LT | Fiber Optic - Underground | Existing fiber optic lines to remain. Contractor will be installing 54" and 12" storm sewers across the fiber optic lines.<br>Fiber Optic lines shall be protected from damage by the Contractor during construction of storm sewer. | City of Lake Forest |
| Deerpath Road Sta.50+44, 26' LT | Fiber Optic - Underground | Existing fiber optic lines to remain. Contractor will be installing a 12" storm sewer across the fiber optic lines.<br>Fiber Optic lines shall be protected from damage by the Contractor during construction of storm sewer. | City of Lake Forest |

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| Deerpath Road Sta.55+21, 31' LT | Fiber Optic - Underground | Existing fiber optic lines to remain. Contractor will be installing a 42" storm sewer across the fiber optic lines. Fiber Optic lines shall be protected from damage by the Contractor during construction of storm sewer. | City of Lake Forest |
| Deerpath Road Sta.55+97, 28' LT | Fiber Optic - Underground | Existing fiber optic lines to remain. Contractor will be installing a 12" storm sewer across the fiber optic lines. Fiber Optic lines shall be protected from damage by the Contractor during construction of storm sewer. | City of Lake Forest |
| Deerpath Road Sta. 67+18, 25' LT | Fiber Optic - Underground | Existing fiber optic line conflicts with a proposed 54" storm sewer. Contractor for the City of Lake Forest shall contact the IDOT Contractor at least 72 hours prior to sewer installation to coordinate activities and temporarily lift and support fiber optic lines to allow sewer installation. | City of Lake Forest |
| Deerpath Road Sta. 68+93, 25' LT | Fiber Optic - Underground | Existing fiber optic line conflicts with a proposed 42" storm sewer. Contractor for the City of Lake Forest shall contact the IDOT Contractor at least 72 hours prior to sewer installation to coordinate activities and temporarily lift and support fiber optic lines to allow sewer installation. | City of Lake Forest |
| Deerpath Road Sta. 51+61, 272' LT | Fiber Optic - Underground | Existing fiber optic lines to remain. Contractor will be installing a jacked storm sewer and 72" casing pipe across the fiber optic line. Fiber Optic line shall be protected from damage by the Contractor during jacking operations. Test hole required to confirm clearance. | AT&T Transmission |

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| Deerpath Road<br>Sta. 51+61,<br>8' RT | Fiber Optic -<br>Underground | Existing fiber optic lines to remain. Contractor will be installing storm sewer main drains across the fiber optic lines.<br>Fiber Optic lines shall be protected from damage by the Contractor during construction of storm sewer and other improvements. | AT&T Transmission |
| Deerpath Road<br>Sta. 51+72,<br>272' LT | Fiber Optic -<br>Underground | Existing fiber optic lines to remain. Contractor will be installing a jacked storm sewer and 72" casing pipe across the the fiber optic line<br>Fiber Optic line shall be protected from damage by the Contractor during jacking operations. Test hole required to confirm clearance. | Sprint |
| Deerpath Road<br>Sta. 51+72,<br>8' RT | Fiber Optic -<br>Underground | Existing fiber optic lines to remain. Contractor will be installing storm sewer main drains across the fiber optic lines.<br>Fiber Optic lines shall be protected from damage by the Contractor during construction of storm sewer and other improvements. | Sprint |
| Deerpath Road<br>Sta. 51+80,<br>272' LT | Fiber Optic -<br>Underground | Existing fiber optic lines to remain. Contractor will be installing a jacked storm sewer and 72" casing pipe across the fiber optic line.<br>Fiber Optic line shall be protected from damage by the Contractor during jacking operations. No conflict. - Clearance confirmed by the utility company. | Level 3<br>Communications/<br>Centurylink |
| Deerpath Road<br>Sta. 51+80,<br>8' RT | Fiber Optic -<br>Underground | Existing fiber optic lines to remain. Contractor will be installing storm sewer main drains across the fiber optic lines.<br>Fiber Optic lines shall be protected from damage by the Contractor during construction of storm sewer and other improvements. | Level 3<br>Communications/<br>Centurylink |

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| Deerpath Road<br>Sta. 52+04,<br>272' LT | Fiber Optic -<br>Underground | Existing fiber optic lines to remain. Contractor will be installing a jacked storm sewer and 72" casing pipe across the fiber optic line.<br>Fiber Optic line shall be protected from damage by the Contractor during jacking operations. Test hole required to confirm clearance. | ComEd |
| Deerpath Road<br>Sta. 52+04,<br>8' RT | Fiber Optic -<br>Underground | Existing fiber optic lines to remain. Contractor will be installing storm sewer main drains across the fiber optic lines.<br>Fiber Optic lines shall be protected from damage by the Contractor during construction of storm sewer and other improvements. | ComEd |
| Deerpath Road<br>Sta. 44+50,16' RT<br>to<br>Sta. 48+13,16' RT | Electric –<br>Underground | Existing electric duct bank to remain. Contractor will be installing a storm sewer main drain in close proximity parallel to the duct bank.<br>Electric duct bank shall be protected from damage by the Contractor during construction of storm sewer improvements. | ComEd |
| Deerpath Road<br>Sta. 52+17<br>to<br>Sta. 52+85 | Electric –<br>Aerial | Contractor will be installing a storm sewer main drain below the high tension power Transmission lines. Contractor shall exercise extreme caution to avoid damaging the high tension power lines during construction of storm sewer improvements below. | ComEd |
| Deerpath Road<br>Sta. 50+94,14' RT<br>to<br>Sta. 52+49,14' RT | Telephone –<br>Underground | Existing telephone duct bank to remain. Contractor will be installing a storm sewer main drain in close proximity parallel to the duct bank.<br>Telephone duct bank shall be protected from damage by the Contractor during construction of storm sewer improvements. | AT&T Distribution |

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|---|---|---|---|
| Deerpath Road Sta. 54+00, 18'-23' RT | Telephone – Underground | 3 Existing telephone duct banks to remain. Contractor will be installing a storm sewer main drain below the duct banks. Telephone duct banks shall be protected from damage by the Contractor during construction of storm sewer improvements. | AT&T Distribution |

**Stage 2**

| STAGE / LOCATION | TYPE | DESCRIPTION | OWNER |
|---|---|---|---|
| Deerpath Road Sta. 55+20, 31' LT | Gas | Existing 8" gas line to remain. Contractor will be installing a 54" storm sewer across (below) the gas line. Gas line shall be protected from damage by the Contractor during construction of storm sewer improvements. | North Shore Gas |
| Deerpath Road Sta. 67+19, 30' LT and Sta. 68+83, 29' LT | Gas | 8" gas relocated in Stage-1. Contractor will be installing 54" and 42" storm sewers across (above) the gas line. Gas main shall be protected from damage by the Contractor during construction of storm sewer improvements. | North Shore Gas |
| Deerpath Road Sta. 53+72, 181' RT to Sta. 55+25, 48' RT | Storm Sewer | Existing 33" storm sewer main drain pipe is in close proximity to the proposed building excavation and site improvements. Contractor shall protect the storm sewer main drain during construction of site improvements. CTV fiber optic lines shall be protected from damage by the Contractor during construction of storm sewer improvements. | City of Lake Forest |

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|---|---|---|---|
| Deerpath Road / Ahwahnee Road Sta. 65+05,95' RT to Sta. 65+70,28' RT | CTV Fiber Optic – Underground | Existing fiber optic line to remain. Contractor will be installing a storm sewer main drain in close proximity parallel to the duct bank. CTV fiber optic lines shall be protected from damage by the Contractor during construction of storm sewer improvements. | Comcast |
| Deerpath Road Sta. 65+66, 12' RT | CTV Coaxial Cable – Underground | Existing cable line to remain. Contractor will be removing and re-installing a storm sewer main drain across the utility line. Cable line shall be protected from damage by the Contractor during construction of storm sewer improvements. | Comcast |

The following contact information is what was used during the preparation of the plans as provided by the owner of the facility.

| Agency/Company Responsible to Resolve Conflict | Name of contact | Phone | E-mail address |
|---|---|---|---|
| **North Shore Gas** (see UTILITIES TO BE WATCHED AND PROTECTED above for additional contact information) | Chris Elvambuena, E.I.T.<br><br>Jay Hammer | (847) 263-4680<br><br>(847) 263-4678 | Noel.Elvambuena@northshoregasdelivery.com<br><br>jay.hammer@northshoregasdelivery.com |
| **City of Lake Forest** | Bernard Pondexter<br><br>Becky Pocasangre | (847) 810-3556<br><br>(847) 810-3543 | pondextb@cityoflakeforest.com<br><br>pocasanb@cityoflakeforest.com |
| **AT&T Distribution (Legal Mandate)** | Hector Garcia<br><br>Darrel Brown | (630) 573-5465<br><br>(630) 573-6496 | hg2929@att.com<br><br>db1324@att.com |
| **Teleport/ AT&T LNS** | Jason Sterenberg<br><br>Jen Wilson | (630) 487-5449 | jsterenberg@cgroupmail.com<br><br>Jw304b@att.com |

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|---|---|---|---|
| **AT&T Transmission** | Ken Colwell<br><br>Rich Meyers | (312) 734-2223<br><br>(630) 383-9249 | kc1298@att.com |
| **ComEd** | Inam Sharif<br><br>Vincent Mazzaferro, PE | (847) 816-5541<br><br>(779) 231-1027 | http://www.comed.com/newbusiness |
| **Comcast Cable** | Nick Mihalka<br><br>Robert Stoll | (224) 229-4513<br><br>(224) 229-5861 | ROBERT_STOLL2@comcast.com |
| **Level 3 Communications/ Centurylink** | Kendall Williams-Zetina<br><br>Ben Pacocha | (918) 547-0547<br><br>(847) 954-8250 | Kendall.Zetina@centurylink.com<br><br>Ben.pacocha@level3.com |
| **TDS Metrocom** | Matthew Schulte | (262) 754-3063 | Matt.schulte@tdstelecom.com |
| **MCI / Verizon** | Joe B. Chaney Jr. | (312) 617-2131 | Joe.Chaney@Verizon.com |
| **Sprint** | Steven T. Hughes | (513) 459-5796 | Steven.Hughes1@T-Mobile.com |

The above represents the best information available to the Department and is included for the convenience of the bidder. The days required for conflict resolution should be considered in the bid as this information has also been factored into the timeline identified for the project when setting the completion date. The applicable portions of the Standard Specifications for Road and Bridge Construction shall apply.

Estimated duration of time provided above for the first conflicts identified will begin on the date of the executed contract regardless of the status of the utility relocations. The responsible agencies will be working toward resolving subsequent conflicts in conjunction with contractor activities in the number of days noted.

The estimated relocation duration must be part of the progress schedule submitted by the contractor. A utility kickoff meeting will be scheduled between the Department, the Department's contractor and the utility companies when necessary. The Department's contractor is responsible for contacting J.U.L.I.E. prior to all excavation work.

**EXISTING UTILITIES**

The Contractor shall familiarize himself with the locations of all utilities and structures that may be found in the vicinity of the construction. The Contractor shall conduct his operations to avoid damage to the above-mentioned utilities and structures. Should any damage occur due to the Contractor's negligence, repairs shall be made by the Contractor at his expense in a manner acceptable to the Engineer.

The Contractor shall notify all utility owners of his construction schedule and shall coordinate constructions operations with utility owners so that relocation of utility lines and structures may proceed in an orderly manner. Notification shall be in writing, with copies transmitted to the Engineer.

**MAINTENANCE OF ROADWAYS**
Effective: September 30, 1985 Revised: November 1, 1996

Beginning on the date that work begins on this project, the Contractor shall assume responsibility for normal maintenance of all existing roadways within the limits of the improvement. This normal maintenance shall include all repair work deemed necessary by the Engineer, but shall not include snow removal operations. Traffic control and protection for maintenance of roadways will be provided by the Contractor as required by the Engineer.

If items of work have not been provided in the contract, or otherwise specified for payment, such items, including the accompanying traffic control and protection required by the Engineer, will be paid for in accordance with Article 109.04 of the Standard Specifications.

**KEEPING ARTERIAL ROADWAYS OPEN TO TRAFFIC (LANE CLOSURES ONLY)**
Effective: January 22, 2003 Revised: August 10, 2017

The Contractor shall provide the necessary traffic control devices to warn the public and to delineate the work zone as required in these Special Provisions, the Standard Specifications, the State Standards, and the District Details.

Arterial lane closures shall be in accordance with the Standard Specifications, Highway Standards, District Details, and the direction of the Engineer. The Contractor shall request and gain approval from the Engineer seventy–two (72) hours in advance of all long-term (24 hrs. or longer) lane closures.

Arterial lane closures not shown in the staging plans will not be permitted during **peak traffic volume hours**.

Peak traffic volume hours are defined as weekdays (Monday through Friday) from
**7:00 AM to 9:00 AM northbound and 4:00 PM to 6:00 PM southbound.7:00 AM to 9:00 AM eastbound and 4:00 PM to 6:00 PM westbound.**
**7:00 AM to 9:00 AM southbound and 4:00 PM to 6:00 PM northbound.7:00 AM to 9:00 AM westbound and 4:00 PM to 6:00 PM eastbound.**

Private vehicles shall not be parked in the work zone. Contractor's equipment and/or vehicles shall not be parked on the shoulders or in the median during non-working hours. The parking of equipment and/or vehicles on State right-of-way will only be permitted at locations approved by the Engineer in accordance with Articles 701.08 and 701.11 of the Standard Specifications.

Should the Contractor fail to completely open and keep open all the traffic lanes to traffic in accordance with the limitations specified above, the Contractor shall be liable to the Department for the amount of:

One lane or ramp blocked = $ $1,000

Two lanes blocked = $ N/A

Not as a penalty but as liquidated and ascertained damages for each and every 15 minute interval or a portion thereof that a lane is blocked outside the allowable time limitations. Such damages may be deducted by the Department from any monies due the Contractor. These damages shall apply during the contract time and during any extensions of the contract time.

**TRACK AND GROUND MONITORING**

Description.

This work shall consist of providing pre-construction, during construction, and post-construction track surveys and daily monitoring of the Union Pacific Railroad (UPRR) tracks for vertical and horizontal potential displacements during operations associated with the jacking of the 72 inch steel casing pipe underneath the railroad corridor and tracks, and the installation of the proposed 54" storm sewer pipe. These operations include, but are not limited to:

1. Excavation of jacking and receiving pits
2. Jacking of steel casing pipe
3. Insertion of storm sewer pipe into casing pipe
4. Backfilling and restoration of jacking and receiving pits
5. Documenting all conditions photographically

The Contractor shall submit a track monitoring plan to the Engineer a minimum of forty five (45) calendar days prior to the start of any work within the UPRR right of way for the engineer's and the UPRR's review and approval. The purpose of the track monitoring plan is to monitor the track's vertical and horizontal position prior to, during, and after construction, and to have a contingency plan prepared in the event of track displacement beyond acceptable limits due to proposed work within railroad right of way. The track monitoring plan shall be in compliance with the description of the work described below.

The Contractor will not be allowed to begin work within the Union Pacific Railroad right of way until written approval of the Contractor's track monitoring plan and contingency plan is received from the UPRR and the supervising engineer.

**Ground Monitoring**

Provide means for monitoring ground settlement. Submit monitoring plan for Railroad review. Ground monitoring points should be in alignment above the proposed construction activities and according to the schedule as described below for pre-construction, during construction, and post-construction activities.

Pre-Construction:

A pre-construction track survey and inspection shall be performed prior to any construction operations taking place which shall consist of the following:

- Establish a bench mark in the vicinity of the construction area. Establish locations for shooting elevations on the top of rail at each area of construction.
- The Contractor will establish an existing track alignment for both sets of tracks extending 1,000 feet along the track in both directions from the centerline of the proposed casing pipe crossing.
- The survey shots will be taken at intervals from the center of the casing pipe crossing at 10, 20, 30, 40 and 50 feet, then every 50 feet for a distance of 1,000 feet in both directions along the existing rails.
- Survey shots shall be taken at the top of each rail (or side of rail using targets), centerline of track, and at the outside edges of the tie for a total of 5 shots at each interval crossing for each rail crossing. There are two tracks being crossed which will require a total of 10 shots to be taken at each interval crossing.
- Use of monitoring targets shall be used and placed such that monitoring is possible when a train is present.
- Adhesive backed reflective targets may be attached to the side of the rail temporarily. Targets should be removed once monitoring phase is complete.

- The survey shall be taken for a period of fourteen (14) consecutive calendar days prior to the start of the jacking operation.
- The survey shall be coordinated with the Engineer and the UPRR (Jason M. Murray, (402) 544-2623) at least fourteen (14) calendar days prior to any activity that precedes construction.
- The pre-construction track survey shall be documented and tabulated for weekly submittal to the Engineer and the UPRR (Jason M. Murray, (402) 544-2623) for review.

During Construction:

Daily monitoring shall consist of the Contractor surveying the same points taken during the pre-construction track survey, taking horizontal and vertical measurements and recording results in a field log book dedicated for this purpose. Copies of the field log entries shall be made available to all concerned parties upon request at any time during construction. Daily monitoring shall only occur from the date the Contractor begins work through the date the Contractor completes work within the UPRR ROW.

Track conditions shall be documented and tabulated for weekly submittal to the Engineer and the UPRR (Jason M. Murray, (402) 544-2623) for review. If any measurements exceed ¼" vertical or horizontal of the pre-construction track survey, the Contractor must discontinue construction operations immediately and notify the Engineer and UPRR to evaluate the track condition.

The Contractor shall provide an established contingency plan in the event of ground loss and/or if the rail deviates ¼ inch vertical or horizontal and shall perform any restorative work at his/her own expense prior to resuming construction operations. If track repairs are required, the Contractor shall use a qualified specialty contractor experienced in UPRR track work and approved by UPRR in advance to perform corrective track repairs to the satisfaction of UPRR, and the Engineer. These repairs can include but are not limited to elevations adjustments, realignment, replacement of track units or hardware or other work to restore the existing tracks to pre-construction conditions and shall be performed at no additional cost to the Department or UPRR.

Post-Construction:

The Contractor shall complete a post-construction track survey and inspection after completion of the operation. The post-construction track survey shall consist of the Contractor surveying the same points taken during the pre-construction track survey, taking horizontal and vertical measurements, for a period of 7 days or longer as required by the Railroad for up to 30 days.

The post-construction track survey shall be documented and tabulated for weekly submittal to the Engineer and the UPRR Utilities Contact (Jason M. Murray, (402) 544-2623) for review.

**Contingency Plans**

The Contractor shall supply Contingency Plan(s), which anticipate reaching the Threshold and Shutdown values, for all construction activities which may result in horizontal and/or vertical track deflection.

Track monitoring values:
Threshold value = 1/8 inch permanent vertical or horizontal deflection
Shutdown value = 1/4 inch permanent vertical or horizontal deflection

The Contingency Plans shall provide means and methods, with options if necessary. The Contractor should anticipate the need to implement each Contingency Plan with required materials, equipment and personnel.

Once the Threshold value is met, the contractor shall determine the appropriate Contingency Plan(s) and immediately discuss this plan with, and receive approval confirmation from, the Railroad.

Once the Shutdown value is exceeded, all project work shall stop and the chosen Contingency Plan shall commence.

The Railroad may choose to allow and/or require the immediate implementation of specific approved Contingency Plans, submitted by the Contractor, once the Shutdown value is exceeded.

Method of Measurement.

This work will not be measured for payment.

Basis of Payment.

This work shall not be paid for separately and shall be included in the contract unit price for STORM SEWERS JACKED IN PLACE, 54", and shall include all track and ground monitoring involved for the specified operation.

**UNION PACIFIC RAILROAD COORDINATION**

# EXHIBIT D

TO PUBLIC ROAD CROSSING OVERPASS/UNDERPASS AGREEMENT

MINIMUM CONSTRUCTION REQUIREMENTS

## 1.01 DESCRIPTION

This project includes construction work within the right-of-way and/or properties of the Union Pacific Railroad Company ("UPRR") and adjacent to its tracks, wire lines and other facilities. This section describes the minimum special requirements for coordination with UPRR when work by the Contractor will be performed upon, over or under the UPRR right-of-way or may impact current or future UPRR operations. The Contractor will coordinate with UPRR while performing the work outlined in this Contract, and shall afford the same cooperation with UPRR as it does with the Agency. All submittals and work shall be completed in accordance with UPRR Guidelines and AREMA recommendations as modified by these minimum special requirements or as directed in writing by the UPRR Designated Representative.

For purposes of this project, the UPRR Designated Representative shall be the person or persons designated by the UPRR Manager of Industry and Public Projects to handle specific tasks related to the project.

## 1.02 DEFINITION OF AGENCY AND CONTRACTOR

As used in these UPRR requirements, the term "Agency" shall mean the Political Body.

As used in these UPRR requirements, the term "Contractor" shall mean the contractor or contractor's hired by the Agency to perform any project work on any portion of UPRR's property and shall also include the contractor's subcontractor's and the contractor's and subcontractor's respective officer, agents and employees, and others acting under its or their authority.

## 1.03 UPRR CONTACTS

The primary UPRR point of contact for this project is:

*Richard Ellison*
*101 N Wacker Drive*
*Suite 1920*
*Chicago, IL 60606*
*312-777-2048*

For UPRR flagging services and track work, contact:

*Daryl Clark*
*708-649-5273*

## 1.04 REQUEST FOR INFORMATION / CLARIFICATION

All Requests for Information ("RFI") involving work within any UPRR right-of-way shall be in accordance with the procedures listed elsewhere in these bid documents. All RFI's shall be submitted to the Engineer of Record. The Engineer of Record will submit the RFI to the UPRR Designated Representative for review and approval for RFI's corresponding to work within the UPRR right-of-way. The Contractor shall allow four (4) weeks for the review and approval process by UPRR.

**1.05 PLANS / SPECIFICATIONS**

The plans and specifications for this project, affecting the UPRR, are subject to the written approval by the UPRR and changes in the plans may be required after award of the Contract. Such changes are subject to the approval of the Agency and the UPRR.

**1.06 UTILITIES AND FIBER OPTICS**

All installations shall be constructed in accordance with current AREMA recommendations and UPRR specifications and requirements. UPRR general guidelines and the required application forms for utility installations can be found on the UPRR website at uprr.com.

**1.07 GENERAL**

A. Contractor shall perform all its work in compliance with all applicable UPRR and FRA rules and regulations. Contractor shall arrange and conduct its work in such manner and at such times as shall not endanger or interfere with the safe operation of the tracks and property of UPRR and the traffic moving on such tracks, or the wires, signals and other property of UPRR, its tenants or licensees, at or in the vicinity of the Work. UPRR shall be reimbursed by Contractor or Agency for train delay cost and lost revenue claims due to any delays or interruption of train operations resulting from Contractor's construction or other activities.

B. Construction activities will be permitted within 12 feet of the operational tracks only if absolutely necessary and UPRR's Designated Representative grants approval. Construction activities within 12 feet of the operational track(s) must allow the tracks to stay operational.

C. Track protection is required for all work equipment (including rubber tired equipment) operating within 25 feet from nearest rail.

D. The Contractor is also advised that new railroad facilities within the project may be built by UPRR and that certain Contractor's activities cannot proceed until that work is completed. The Contractor shall be aware of the limits of responsibilities and allow sufficient time in the schedule for that work to be accomplished and shall coordinate its efforts with the UPRR.

**1.08 RAILROAD OPERATIONS**

A. The Contractor shall be advised that trains and/or equipment are expected on any track, at any time, in either direction. Contractor shall be familiar with the train schedules in this location and structure its bid assuming intermittent track windows in this period, as defined in Paragraph B below.

B. All railroad tracks within and adjacent to the Contract Site are active, and rail traffic over these facilities shall be maintained throughout the Project. Activities may include both through moves and switching moves to local customers. Railroad traffic and operations will occur continuously throughout the day and night on these tracks and shall be maintained at all times as defined herein. The Contractor shall coordinate and schedule the work so that construction activities do not interfere with railroad operations.

C. Work windows for this Contract shall be coordinated with the Agency's and the UPRR's Designated Representatives. Types of work windows include Conditional Work Windows and Absolute Work Windows, as defined below:

1. Conditional Work Window: A Conditional Work Window is a period of time that railroad operations have priority over construction activities. When construction activities may occur on and adjacent to the railroad tracks within 25 feet of the nearest track, a UPRR flag person will be required. At the direction of the UPRR flag person, upon approach of a train, and when trains are present on the tracks, the tracks must be cleared (i.e., no construction equipment, materials or personnel within 25 feet, or as directed by the UPRR Designated Representative, from the tracks). Conditional Work Windows are available for the Project.

2. Absolute Work Window: An Absolute Work Window is a period of time that construction activities are given priority over railroad operations. During this time frame the designated railroad track(s) will be inactive for train movements and may be fouled by the Contractor. At the end of an Absolute Work Window the railroad tracks and/or signals must be completely operational for train operations and all UPRR, Public Utilities Commission (PUC) and Federal Railroad Administration (FRA) requirements, codes and regulations for operational tracks must be complied with. In the situation where the operating tracks and/or signals have been affected, the UPRR will perform inspections of the work prior to placing that track back into service. UPRR flag persons will be required for construction activities requiring an Absolute Work Window. **Absolute Work Windows will not generally be granted. Any request will require a detailed explanation for UPRR review.**

**1.09 RIGHT OF ENTRY, ADVANCE NOTICE AND WORK STOPPAGES**

A. Prior to beginning any work on or over the property of, or affecting the facilities of, the UPRR, the Contractor shall enter into an agreement with the UPRR in the form of the "Contractor's Right of Entry Agreement", attached as **Exhibit E**, or latest version thereof provided by the UPRR. There is a fee for processing of the agreement. This cost shall be borne by the Contractor. Contractor shall submit a copy of the executed agreement and the insurance policies, binders, certificates and endorsements set forth therein to the Agency prior to commencing work on UPRR property. The right of entry agreement shall specify working time frames, flagging and inspection requirements, and any other items specified by the UPRR.

B. The Contractor shall give the advance notice to the UPRR as required in the "Contractor's Right of Entry Agreement" before commencing work in connection with construction upon or over UPRR's right-of-way and shall observe UPRR's rules and regulations with respect thereto.

C. All work upon UPRR's right-of-way shall be done at such times and in such manner as not to interfere with or endanger the operations of UPRR. Whenever work may affect the operations or safety of trains, the method of doing such work shall first be submitted to UPRR's Designated Representative for approval, but such approval shall not relieve the Contractor from liability. Any work to be performed by the Contractor, which requires flagging service or inspection service, shall be deferred until the flagging protection required by UPRR is available at the job site. See Section 3.18 for railroad flagging requirements.

D. The Contractor shall make requests in writing for both Absolute and Conditional Work Windows, at least two weeks in advance of any work. The written request must include:

1. Exactly what the work entails.
2. The days and hours that work will be performed.
3. The exact location of work, and proximity to the tracks.
4. The type of window requested and the amount of time requested.
5. The designated contact person.

The Contractor shall provide a written confirmation notice to the UPRR at least 48 hours before commencing work in connection with approved work windows when work will be performed within **25 feet of any track center line.** All work shall be performed in accordance with previously approved work plans.

E. Should a condition arising from, or in connection with the work, require that immediate and unusual provisions be made to protect operations and property of UPRR, the Contractor shall make such provisions. If in the judgment of UPRR's Designated Representative such provisions are insufficient, the UPRR's Designated Representative may require or provide such provisions as deemed necessary. In any event, such provisions shall be at the Contractor's expense and without cost to the UPRR. UPRR or the Agency shall have the right to order Contractor to temporarily cease operations in the event of an emergency or, if in the opinion of the UPRR's Designated Representative, the Contractor's operations could endanger UPRR's operations. In the event such an order is given, Contractor shall immediately notify the Agency of the order.

**1.10 INSURANCE**

Contractor shall not begin work upon or over UPRR's right-of-way until UPRR has been furnished the insurance policies, binders, certificates and endorsements required by the "Contractor's Right-of-Entry Agreement" and UPRR's Designated Representative has advised the Agency that such insurance is in accordance with the Agreement. The required insurance shall be kept in full force and effect during the performance of work and thereafter until Contractor removes all tools, equipment, and material from UPRR's property and cleans the premises in a manner reasonably satisfactory to UPRR.

**1.11 RAILROAD SAFETY ORIENTATION**

**All personnel employed by the Contractor and all subcontractors must complete the UPRR course "Orientation for Contractor's Safety", and be registered prior to working on UPRR property. This orientation is available at www.contractororientation.com. This course is required to be completed annually.**

**1.12 COOPERATION**

UPRR will cooperate with Contractor so that work may be conducted in an efficient manner, and will cooperate with Contractor in enabling use of UPRR's right-of-way in performing the work.

**1.13 MINIMUM CONSTRUCTION CLEARANCES FOR FALSEWORK AND OTHER TEMPORARY STRUCTURES**

The Contractor shall abide by the following minimum temporary clearances during the course of construction:

A. 12' – 0" horizontal from centerline of track
B. 21' – 0" vertically above top of rail.

For construction clearance less than listed above, local Operating Unit review and approval is required.

**1.14 APPROVAL OF REDUCED CLEARANCES**

A. The minimum track clearances to be maintained by the Contractor during construction are specified in Section 3.07 herein.

B. Any proposed infringement on the specified minimum clearances due to the Contractor's operations shall be submitted to UPRR's Designated Representative through the Agency at least 30 days in advance of the work and shall not be undertaken until approved in writing by the UPRR's Designated Representative.

C. No work shall commence until the Contractor receives in writing assurance from UPRR's Designated Representative that arrangements have been made for flagging service, as may be necessary and receives permission from UPRR's Designated Representative to proceed with the work.

**1.15 CONSTRUCTION AND AS-BUILT SUBMITTALS**

A. Submittals are required for construction materials and procedures as outlined below. The submittals shall include all review comments from the Agency and the Engineer of Record. All design submittals shall be stamped and signed by a Professional Engineer registered in the State of Illinois.

B. The tables below provide UPRR's minimum submittal requirements for the construction items noted. Submittal requirements are in addition to those specified elsewhere in these bid documents. The minimum review times indicated below represent UPRR's requirements only. The Contractor shall allow additional time for the Agency's review time as stated elsewhere in these bid documents.

C. Submittals shall be made by the Agency to the UPRR Manager of Industry and Public Projects unless otherwise directed by the Railroad. Items in Table 1 shall be submitted for both railroad overpass and underpass projects, as applicable. Items in Table 2 shall be submitted for railroad underpass projects only.

TABLE 1

| **ITEM** | DESCRIPTION | SETS REQD. | UPRR's Minimum Review Time |
|---|---|---|---|
| 1 | Shoring design and details | 4 | 4 weeks |
| 2 | Falsework design and details | 4 | 4 weeks |
| 3 | Drainage design provisions | 4 | 4 weeks |
| 4 | Erection diagrams and sequence | 4 | 4 weeks |
| 5 | Demolition diagram and sequence | 4 | 4 weeks |

**Prior to or during construction of railroad underpass structures, the UPRR requires the review of drawings, reports, test data and material data sheets to determine compliance with the specifications. Product information for items noted in Table 2 be submitted to UPRR's Designated Representative through the Agency for their own review and approval of the material. The signed submittal and the Agency's review comments will be reviewed by UPRR or their consultant. If a consultant performs the reviews, the consultant may reply directly to the Agency or its Designated Representative after consultation with UPRR. Review of the submittals will not be conducted until after review by the Agency or its Designated Representative. Review of the submittal items will require a minimum of four (4) weeks after receipt from the Agency.**

TABLE 2

| ITEM | DESCRIPTION | SETS REQD. | NOTES |
|---|---|---|---|
| 1 | Shop drawings | 4 | Steel and Concrete members |
| 2 | Bearings | 4 | For all structures |
| 3 | Concrete Mix Designs | 4 | For all structures |
| 4 | Rebar & Strand certifications | 4 | For superstructure only |
| 5 | 28 day concrete strength | 4 | For superstructure only |
| 6 | Waterproofing material certifications and installation procedure | 4 | Waterproofing & protective boards |
| 7 | Structural steel certifications | 4 | All fracture critical members & other members requiring improved notch toughness |
| 8 | Fabrication and Test reports | 4 | All fracture critical members & other members requiring improved notch toughness |
| 9 | Welding Procedures and Welder Certification | 4 | AWS requirements |
| 10 | Foundation Construction Reports | 4 | Pile driving, drilled shaft construction, bearing pressure test reports for spread footings |
| 11 | Compaction testing reports for backfill at abutments | 4 | Must meet 95% maximum dry density, Modified Proctor ASTM D1557 |

D. As-Built Records shall be submitted to the UPRR within 60 days of completion of the structures. These records shall consist of the following items:

**Overpass Projects**

1. Electronic files of all structure design drawings with as-constructed modifications shown, in Microstation J or Acrobat .PDF format.
2. Hard copies of all structure design drawings with as-constructed modifications shown.

**Underpass Projects**

1. Electronic files of all structure design drawings with as-constructed modifications shown, in Microstation SE or Acrobat .PDF format.

2. Hard copies of all structure design drawings with as-constructed modifications shown.
3. Final approved copies of shop drawings for concrete and steel members.
4. Foundation Construction Reports
5. Compaction testing reports for backfill at abutments

**1.16 APPROVAL OF DETAILS**

The details of the construction affecting the UPRR tracks and property not already included in the Contract Plans shall be submitted to UPRR's Designated Representative through the Agency for UPRR's review and written approval before such work is undertaken. Review and approval of these submittals will require a minimum of four (4) weeks in addition to the Agency's review time as stated elsewhere in these bid documents.

**1.17 MAINTENANCE OF RAILROAD FACILITIES**

A. The Contractor shall be required to maintain all ditches and drainage structures free of silt or other obstructions which may result from Contractor's operations; to promptly repair eroded areas within UPRR's right of way and to repair any other damage to the property of UPRR, or its tenants.

B. All such maintenance and repair of damages due to the Contractor's operations shall be done at the Contractor's expense.

C. The Contractor must submit a proposed method of erosion control and have the method reviewed by the UPRR prior to beginning any grading on the Project Site. Erosion control methods must comply with all applicable local, state and federal regulations.

**1.18 SITE INSPECTIONS BY UPRR's DESIGNATED REPRESENTATIVE**

A. In addition to the office reviews of construction submittals, site inspections may be performed by UPRR's Designated Representative at significant points during construction, including the following if applicable:

1. Pre-construction meetings.
2. Pile driving/drilling of caissons or drilled shafts.
3. Reinforcement and concrete placement for railroad bridge substructure and/or superstructure.
4. Erection of precast concrete or steel bridge superstructure.
5. Placement of waterproofing (prior to placing ballast on bridge deck).
6. Completion of the bridge structure.

B. Site inspection is not limited to the milestone events listed above. Site visits to check progress of the work may be performed at any time throughout the construction as deemed necessary by UPRR.

C. A detailed construction schedule, including the proposed temporary horizontal and vertical clearances and construction sequence for all work to be performed, shall be provided to the Agency for submittal to UPRR's Designated Representative for review prior to commencement of work. This schedule shall also include the anticipated dates when the above listed events will occur. This schedule shall be updated for the above listed events as necessary, but at least monthly so that site visits may be scheduled.

**1.19 UPRR REPRESENTATIVES**

A. UPRR representatives, conductors, flag person or watch person will be provided by UPRR at expense of the Agency or Contractor (as stated elsewhere in these bid documents) to protect UPRR facilities, property and movements of its trains or engines. In general, UPRR will furnish such personnel or other protective services as follows:

B. When any part of any equipment is standing or being operated within 25 feet, measured horizontally, from centerline of any track on which trains may operate, or when any object is off the ground and any dimension thereof could extend inside the 25 foot limit, or when any erection or construction activities are in progress within such limits, regardless of elevation above or below track.

C. For any excavation below elevation of track subgrade if, in the opinion of UPRR's Designated Representative, track or other UPRR facilities may be subject to settlement or movement.

D. During any clearing, grubbing, excavation or grading in proximity to UPRR facilities, which, in the opinion of UPRR's Designated Representative, may endanger UPRR facilities or operations.

E. During any contractor's operations when, in the opinion of UPRR's Designated Representative, UPRR facilities, including, but not limited to, tracks, buildings, signals, wire lines, or pipe lines, may be endangered.

F. The Contractor shall arrange with the UPRR Designated Representative to provide the adequate number of flag persons to accomplish the work.

**1.20 WALKWAYS REQUIRED**

Along the outer side of each exterior track of multiple operated track, and on each side of single operated track, an unobstructed continuous space suitable for trainman's use in walking along trains, extending to a line not less than twelve feet (12') from centerline of track, shall be maintained. Any temporary impediments to walkways and track drainage encroachments or obstructions allowed during work hours while UPRR's flagman service is provided shall be removed before the close of each work day. Walkways with railings shall be constructed by Contractor over open excavation areas when in close proximity of track, and railings shall not be closer than 8' – 6" horizontally from center line of tangent track or 9' – 6" horizontal from curved track.

**1.21 COMMUNICATIONS AND SIGNAL LINES**

If required, UPRR will rearrange its communications and signal lines, its grade crossing warning devices, train signals and tracks, and facilities that are in use and maintained by UPRR's forces in connection with its operation at expense of the Agency. This work by UPRR will be done by its own forces and it is not a part of the Work under this Contract.

**1.22 TRAFFIC CONTROL**

Contractor's operations that control traffic across or around UPRR facilities shall be coordinated with and approved by the UPRR's Designated Representative.

**1.23 CONSTRUCTION EXCAVATIONS**

A. The Contractor shall be required to take special precaution and care in connection with excavating and shoring. Excavations for construction of footings, piers, columns, walls or other facilities that require shoring shall comply with requirements of OSHA, AREMA and UPRR "Guidelines for Temporary Shoring".

B. The Contractor shall contact UPRR's "Call Before Your Dig" at least 48 hours prior to commencing work at 1-800-336-9193 during normal business hours (6:30 a.m. to 8:00 p.m. central time, Monday through Friday, except holidays - also a 24 hour, 7 day a week number for emergency calls) to determine location of fiber optics. If a telecommunications system is buried anywhere on or near UPRR property, the Contractor will co-ordinate with UPRR and the Telecommunication Company(ies) to arrange for relocation or other protection of the system prior to beginning any work on or near UPRR property.

**1.24 RAILROAD FLAGGING**

Performance of any work by the Contractor in which person(s) or equipment will be within twenty-five (25) feet of any track, or will be near enough to any track that any equipment extension (such as, but not limited to, a crane boom) will reach within twenty-five (25) feet of any track, may require railroad flagging services or other protective measures. Contractor shall give the advance notice to the UPRR as required in the "Contractor's Right of Entry Agreement" before commencing any such work, so that the UPRR may determine the need for flagging or other protective measures to ensure the safety of the railroad's operations. Contractor shall comply with all other requirements regarding flagging services covered by the "Contractor's Right of Entry Agreement". Any costs associated with failure to abide by these requirements will be borne by the Contractor.

**The estimated pay rate for each flag person is $748.00 per day for an 8 hour work day with time and one-half for overtime, Saturdays, Sundays; double time and one-half for holidays. Flagging rates are set by the UPRR and are subject to change.**

**1.25 CLEANING OF RIGHT-OF-WAY**

Contractor shall, upon completion of the work to be performed by Contractor upon the premises, over or beneath the tracks of UPRR, promptly remove from the right-of-way of UPRR all of Contractor's tools, implements, and other materials whether brought upon the right-of-way by Contractor or any subcontractors, employee or agent of Contractor or of any subcontractor, and leave the right-of-way in a clean and presentable condition to satisfaction of UPRR.

# EXHIBIT 'E'
# CONTRACTOR'S
# RIGHT OF ENTRY AGREEMENT

**THIS AGREEMENT** is made and entered into as of the _____ day of _____, 20_____,
by and between **UNION PACIFIC RAILROAD COMPANY**, a Delaware corporation ("Railroad"); and _____
_____, a _____ corporation ("Contractor").

**RECITALS**:

Contractor has been hired by _____ to perform work relating to _____
_____
_____
_____
(the "work"), with all or a portion of such work to be performed on property of Railroad in the vicinity of Railroad's Milepost _____ on Railroad's _____ [Subdivision] [Branch] [at or near DOT No. _____] located at or near _____, in _____ County, State of _____, as such location is in the general location shown on the print marked **Exhibit A**, attached hereto and hereby made a part hereof, which work is the subject of a contract dated _____ between Railroad and _____.

Railroad is willing to permit Contractor to perform the work described above at the location described above subject to the terms and conditions contained in this Agreement

**AGREEMENT**:

**NOW, THEREFORE**, it is mutually agreed by and between Railroad and Contractor, as follows:

**ARTICLE 1 - DEFINITION OF CONTRACTOR.**

For purposes of this Agreement, all references in this agreement to Contractor shall include Contractor's contractors, subcontractors, officers, agents and employees, and others acting under its or their authority.

**ARTICLE 2 - RIGHT GRANTED; PURPOSE.**

Railroad hereby grants to Contractor the right, during the term hereinafter stated and upon and subject to each and all of the terms, provisions and conditions herein contained, to enter upon and have ingress to and egress from the property described in the Recitals for the purpose of performing the work described in the Recitals above. The right herein granted to Contractor is limited to those portions of Railroad's property specifically described herein, or as designated by the Railroad Representative named in Article 4.

**ARTICLE 3 - TERMS AND CONDITIONS CONTAINED IN EXHIBITS B, C AND D.**

The terms and conditions contained in **Exhibit B, Exhibit C** and **Exhibit D**, attached hereto, are hereby made a part of this Agreement.

**ARTICLE 4 - ALL EXPENSES TO BE BORNE BY CONTRACTOR; RAILROAD REPRESENTATIVE.**

A. Contractor shall bear any and all costs and expenses associated with any work performed by Contractor, or any costs or expenses incurred by Railroad relating to this Agreement.

B. Contractor shall coordinate all of its work with the following Railroad representative or his or her duly authorized representative (the "Railroad Representative"):

Richard Ellison
101 N. Wacker Drive, Suite 1920
Chicago, IL 60606
(312) 777-2048

C. Contractor, at its own expense, shall adequately police and supervise all work to be performed by Contractor and shall ensure that such work is performed in a safe manner as set forth in Section 7 of **Exhibit B**. The responsibility of Contractor for safe conduct and adequate policing and supervision of Contractor's work shall not be lessened or otherwise affected by Railroad's approval of plans and specifications involving the work, or by Railroad's collaboration in performance of any work, or by the presence at the work site of a Railroad Representative, or by compliance by Contractor with any requests or recommendations made by Railroad Representative.

**ARTICLE 5 - TERM; TERMINATION.**

A. The grant of right herein made to Contractor shall commence on the date of this Agreement, and continue until _____, unless sooner terminated as herein provided, or at such time as Contractor has completed its work on Railroad's property, whichever is earlier. Contractor agrees to notify the Railroad Representative in writing when it has completed its work on Railroad's property.

B. This Agreement may be terminated by either party on ten (10) days written notice to the other party.

**ARTICLE 6 - CERTIFICATE OF INSURANCE.**

A. Before commencing any work, Contractor will provide Railroad with the (i) insurance binders, policies, certificates and endorsements set forth in **Exhibit C** of this Agreement, and (ii) the insurance endorsements obtained by each subcontractor as required under Section 12 of **Exhibit B** of this Agreement.

B. All insurance correspondence, binders, policies, certificates and endorsements shall be sent to:

Union Pacific Railroad Company
1400 Douglas St., MS 1690
Omaha , NE 68179
Attn:Kathy Nesser

Folder No. _____

**ARTICLE 7 - DISMISSAL OF CONTRACTOR's EMPLOYEE.**

At the request of Railroad, Contractor shall remove from Railroad's property any employee of Contractor who fails to conform to the instructions of the Railroad Representative in connection with the work on Railroad's property, and any right of Contractor shall be suspended until such removal has occurred. Contractor shall indemnify Railroad against any claims arising from the removal of any such employee from Railroad's property.

**ARTICLE 8 - ADMINISTRATIVE FEE.**

Upon the execution and delivery of this Agreement, Contractor shall pay to Railroad _____ Dollars ($_____) as reimbursement for clerical, administrative and handling expenses in connection with the processing of this Agreement.

**ARTICLE 9 - CROSSINGS.**

No additional vehicular crossings (including temporary haul roads) or pedestrian crossings over Railroad's trackage shall be installed or used by Contractor without the prior written permission of Railroad.

**ARTICLE 10.- EXPLOSIVES.**

Explosives or other highly flammable substances shall not be stored or used on Railroad's property without the prior written approval of Railroad.

**IN WITNESS WHEREOF**, the parties hereto have duly executed this agreement in duplicate as of the date first herein written.

**UNION PACIFIC RAILROAD COMPANY**

By:_____
Title:_____

____

_____
(Name of Contractor)

By:_____
Title:_____

**EXHIBIT A**

Exhibit A will be a print showing the general location of the work site.

***See plans for general location and site details.***

# EXHIBIT B
# TO
# CONTRACTOR'S RIGHT OF ENTRY AGREEMENT

**Section 1. NOTICE OF COMMENCEMENT OF WORK - FLAGGING.**

A. Contractor agrees to notify the Railroad Representative at least ten (10) working days in advance of Contractor commencing its work and at least thirty (30) working days in advance of proposed performance of any work by Contractor in which any person or equipment will be within twenty-five (25) feet of any track, or will be near enough to any track that any equipment extension (such as, but not limited to, a crane boom) will reach to within twenty-five (25) feet of any track. No work of any kind shall be performed, and no person, equipment, machinery, tool(s), material(s), vehicle(s), or thing(s) shall be located, operated, placed, or stored within twenty-five (25) feet of any of Railroad's track(s) at any time, for any reason, unless and until a Railroad flagman is provided to watch for trains. Upon receipt of such thirty (30)-day notice, the Railroad Representative will determine and inform Contractor whether a flagman need be present and whether Contractor needs to implement any special protective or safety measures. If flagging or other special protective or safety measures are performed by Railroad, Railroad will bill Contractor for such expenses incurred by Railroad, unless Railroad and a federal, state or local governmental entity have agreed that Railroad is to bill such expenses to the federal, state or local governmental entity. If Railroad will be sending the bills to Contractor, Contractor shall pay such bills within thirty (30) days of Contractor's receipt of billing. If Railroad performs any flagging, or other special protective or safety measures are performed by Railroad, Contractor agrees that Contractor is not relieved of any of its responsibilities or liabilities set forth in this Agreement.

B. The rate of pay per hour for each flagman will be the prevailing hourly rate in effect for an eight-hour day for the class of flagmen used during regularly assigned hours and overtime in accordance with Labor Agreements and Schedules in effect at the time the work is performed. In addition to the cost of such labor, a composite charge for vacation, holiday, health and welfare, supplemental sickness, Railroad Retirement and unemployment compensation, supplemental pension, Employees Liability and Property Damage and Administration will be included, computed on actual payroll. The composite charge will be the prevailing composite charge in effect at the time the work is performed. One and one-half times the current hourly rate is paid for overtime, Saturdays and Sundays, and two and one-half times current hourly rate for holidays. Wage rates are subject to change, at any time, by law or by agreement between Railroad and its employees, and may be retroactive as a result of negotiations or a ruling of an authorized governmental agency. Additional charges on labor are also subject to change. If the wage rate or additional charges are changed, Contractor (or the governmental entity, as applicable) shall pay on the basis of the new rates and charges.

C. Reimbursement to Railroad will be required covering the full eight-hour day during which any flagman is furnished, unless the flagman can be assigned to other Railroad work during a portion of such day, in which event reimbursement will not be required for the portion of the day during which the flagman is engaged in other Railroad work. Reimbursement will also be required for any day not actually worked by the flagman following the flagman's assignment to work on the project for which Railroad is required to pay the flagman and which could not reasonably be avoided by Railroad by assignment of such flagman to other work , even though Contractor may not be working during such time. When it becomes necessary for Railroad to bulletin and assign an employee to a flagging position in compliance with union collective bargaining agreements, Contractor must provide Railroad a minimum of five (5) days notice prior to the cessation of the

need for a flagman. If five (5) days notice of cessation is not given, Contractor will still be required to pay flagging charges for the five (5) day notice period required by union agreement to be given to the employee, even though flagging is not required for that period. An additional thirty (30) days notice must then be given to Railroad if flagging services are needed again after such five day cessation notice has been given to Railroad.

**Section 2. LIMITATION AND SUBORDINATION OF RIGHTS GRANTED**

A. The foregoing grant of right is subject and subordinate to the prior and continuing right and obligation of the Railroad to use and maintain its entire property including the right and power of Railroad to construct, maintain, repair, renew, use, operate, change, modify or relocate railroad tracks, roadways, signal, communication, fiber optics, or other wirelines, pipelines and other facilities upon, along or across any or all parts of its property, all or any of which may be freely done at any time or times by Railroad without liability to Contractor or to any other party for compensation or damages.

B. The foregoing grant is also subject to all outstanding superior rights (whether recorded or unrecorded and including those in favor of licensees and lessees of Railroad's property, and others) and the right of Railroad to renew and extend the same, and is made without covenant of title or for quiet enjoyment.

**Section 3. NO INTERFERENCE WITH OPERATIONS OF RAILROAD AND ITS TENANTS.**

A. Contractor shall conduct its operations so as not to interfere with the continuous and uninterrupted use and operation of the railroad tracks and property of Railroad, including without limitation, the operations of Railroad's lessees, licensees or others, unless specifically authorized in advance by the Railroad Representative. Nothing shall be done or permitted to be done by Contractor at any time that would in any manner impair the safety of such operations. When not in use, Contractor's machinery and materials shall be kept at least fifty (50) feet from the centerline of Railroad's nearest track, and there shall be no vehicular crossings of Railroads tracks except at existing open public crossings.

B. Operations of Railroad and work performed by Railroad personnel and delays in the work to be performed by Contractor caused by such railroad operations and work are expected by Contractor, and Contractor agrees that Railroad shall have no liability to Contractor, or any other person or entity for any such delays. The Contractor shall coordinate its activities with those of Railroad and third parties so as to avoid interference with railroad operations. The safe operation of Railroad train movements and other activities by Railroad takes precedence over any work to be performed by Contractor.

**Section 4. LIENS.**

Contractor shall pay in full all persons who perform labor or provide materials for the work to be performed by Contractor. Contractor shall not create, permit or suffer any mechanic's or materialmen's liens of any kind or nature to be created or enforced against any property of Railroad for any such work performed. Contractor shall indemnify and hold harmless Railroad from and against any and all liens, claims, demands, costs or expenses of whatsoever nature in any way connected with or growing out of such work done, labor performed, or materials furnished. If Contractor fails to promptly cause any lien to be released of record, Railroad may, at its election, discharge the lien or claim of lien at Contractor's expense.

**Section 5. PROTECTION OF FIBER OPTIC CABLE SYSTEMS.**

A. Fiber optic cable systems may be buried on Railroad's property. Protection of the fiber optic cable systems is of extreme importance since any break could disrupt service to users resulting in business interruption and loss of revenue and profits. Contractor shall telephone Railroad during normal business hours (7:00 a.m. to 9:00 p.m. Central Time, Monday through Friday, except holidays) at 1-800-336-9193 (also a 24-hour, 7-day number for emergency calls) to determine if fiber optic cable is buried anywhere on Railroad's property to be used by Contractor. If it is, Contractor will telephone the telecommunications company(ies) involved, make arrangements for a cable locator and, if applicable, for relocation or other protection of the fiber optic cable. Contractor shall not commence any work until all such protection or relocation (if applicable) has been accomplished.

b. In addition to other indemnity provisions in this Agreement, Contractor shall indemnify, defend and hold Railroad harmless from and against all costs, liability and expense whatsoever (including, without limitation, attorneys' fees, court costs and expenses) arising out of any act or omission of Contractor, its agents and/or employees, that causes or contributes to (1) any damage to or destruction of any telecommunications system on Railroad's property, and/or (2) any injury to or death of any person employed by or on behalf of any telecommunications company, and/or its contractor, agents and/or employees, on Railroad's property. Contractor shall not have or seek recourse against Railroad for any claim or cause of action for alleged loss of profits or revenue or loss of service or other consequential damage to a telecommunication company using Railroad's property or a customer or user of services of the fiber optic cable on Railroad's property.

**Section 6. PERMITS - COMPLIANCE WITH LAWS.**

In the prosecution of the work covered by this Agreement, Contractor shall secure any and all necessary permits and shall comply with all applicable federal, state and local laws, regulations and enactments affecting the work including, without limitation, all applicable Federal Railroad Administration regulations.

**Section 7. SAFETY.**

A. Safety of personnel, property, rail operations and the public is of paramount importance in the prosecution of the work performed by Contractor. Contractor shall be responsible for initiating, maintaining and supervising all safety, operations and programs in connection with the work. Contractor shall at a minimum comply with Railroad's safety standards listed in **Exhibit D**, hereto attached, to ensure uniformity with the safety standards followed by Railroad's own forces. As a part of Contractor's safety responsibilities, Contractor shall notify Railroad if Contractor determines that any of Railroad's safety standards are contrary to good safety practices. Contractor shall furnish copies of **Exhibit D** to each of its employees before they enter the job site.

B. Without limitation of the provisions of paragraph A above, Contractor shall keep the job site free from safety and health hazards and ensure that its employees are competent and adequately trained in all safety and health aspects of the job.

C. Contractor shall have proper first aid supplies available on the job site so that

prompt first aid services may be provided to any person injured on the job site. Contractor shall promptly notify Railroad of any U.S. Occupational Safety and Health Administration reportable injuries. Contractor shall have a nondelegable duty to control its employees while they are on the job site or any other property of Railroad, and to be certain they do not use, be under the influence of, or have in their possession any alcoholic beverage, drug or other substance that may inhibit the safe performance of any work.

D. If and when requested by Railroad, Contractor shall deliver to Railroad a copy of Contractor's safety plan for conducting the work (the "Safety Plan"). Railroad shall have the right, but not the obligation, to require Contractor to correct any deficiencies in the Safety Plan. The terms of this Agreement shall control if there are any inconsistencies between this Agreement and the Safety Plan.

**Section 8. INDEMNITY.**

A. To the extent not prohibited by applicable statute, Contractor shall indemnify, defend and hold harmless Railroad, its affiliates, and its and their officers, agents and employees (individually an “Indemnified Party” or collectively "Indemnified Parties") from and against any and all loss, damage, injury, liability, claim, demand, cost or expense (including, without limitation, attorney's, consultant's and expert's fees, and court costs), fine or penalty (collectively, "Loss") incurred by any person (including, without limitation, any Indemnified Party, Contractor, or any employee of Contractor or of any Indemnified Party) arising out of or in any manner connected with (i) any work performed by Contractor, or (ii) any act or omission of Contractor, its officers, agents or employees, or (iii) any breach of this Agreement by Contractor.

b. The right to indemnity under this Section 8 shall accrue upon occurrence of the event giving rise to the Loss, and shall apply regardless of any negligence or strict liability of any Indemnified Party, except where the Loss is caused by the sole active negligence of an Indemnified Party as established by the final judgment of a court of competent jurisdiction. The sole active negligence of any Indemnified Party shall not bar the recovery of any other Indemnified Party.

c. Contractor expressly and specifically assumes potential liability under this Section 8 for claims or actions brought by Contractor's own employees. Contractor waives any immunity it may have under worker's compensation or industrial insurance acts to indemnify the Indemnified Parties under this Section 8. Contractor acknowledges that this waiver was mutually negotiated by the parties hereto.

d. No court or jury findings in any employee's suit pursuant to any worker's compensation act or the Federal Employers' Liability Act against a party to this Agreement may be relied upon or used by Contractor in any attempt to assert liability against any Indemnified Party.

e. The provisions of this Section 8 shall survive the completion of any work performed by Contractor or the termination or expiration of this Agreement. In no event shall this Section 8 or any other provision of this Agreement be deemed to limit any liability Contractor may have to any Indemnified Party by statute or under common law.

**Section 9. RESTORATION OF PROPERTY.**

In the event Railroad authorizes Contractor to take down any fence of Railroad or in any manner move or disturb any of the other property of Railroad in connection with the work to be

performed by Contractor, then in that event Contractor shall, as soon as possible and at Contractor's sole expense, restore such fence and other property to the same condition as the same were in before such fence was taken down or such other property was moved or disturbed. Contractor shall remove all of Contractor's tools, equipment, rubbish and other materials from Railroad's property promptly upon completion of the work, restoring Railroad's property to the same state and condition as when Contractor entered thereon.

**Section 10. WAIVER OF DEFAULT.**

Waiver by Railroad of any breach or default of any condition, covenant or agreement herein contained to be kept, observed and performed by Contractor shall in no way impair the right of Railroad to avail itself of any remedy for any subsequent breach or default.

**Section 11. MODIFICATION - ENTIRE AGREEMENT.**

No modification of this Agreement shall be effective unless made in writing and signed by Contractor and Railroad. This Agreement and the exhibits attached hereto and made a part hereof constitute the entire understanding between Contractor and Railroad and cancel and supersede any prior negotiations, understandings or agreements, whether written or oral, with respect to the work to be performed by Contractor.

**Section 12. ASSIGNMENT - SUBCONTRACTING.**

Contractor shall not assign or subcontract this Agreement, or any interest therein, without the written consent of the Railroad. Contractor shall be responsible for the acts and omissions of all subcontractors. Before Contractor commences any work, the Contractor shall, except to the extent prohibited by law; (1) require each of its subcontractors to include the Contractor as "Additional Insured" in the subcontractor's Commercial General Liability policy and Business Automobile policies with respect to all liabilities arising out of the subcontractor's performance of work on behalf of the Contractor by endorsing these policies with ISO Additional Insured Endorsements CG 20 26, and CA 20 48 (or substitute forms providing equivalent coverage; (2) require each of its subcontractors to endorse their Commercial General Liability Policy with "Contractual Liability Railroads" ISO Form CG 24 17 10 01 (or a substitute form providing equivalent coverage) for the job site; and (3) require each of its subcontractors to endorse their Business Automobile Policy with "Coverage For Certain Operations In Connection With Railroads" ISO Form CA 20 70 10 01 (or a substitute form providing equivalent coverage) for the job site.

**EXHIBIT C**
**TO**
**CONTRACTOR'S**
**RIGHT OF ENTRY AGREEMENT**

**Union Pacific Railroad Company**
**Insurance Provisions For**
**Contractor's Right of Entry Agreement**

Contractor shall, at its sole cost and expense, procure and maintain during the course of the Project and until all Project work on Railroad's property has been completed and the Contractor has removed all equipment and materials from Railroad's property and has cleaned and restored Railroad's property to Railroad's satisfaction, the following insurance coverage:

**A.** **Commercial General Liability** insurance. Commercial general liability (CGL) with a limit of not less than $5,000,000 each occurrence and an aggregate limit of not less than $10,000,000. CGL insurance must be written on ISO occurrence form CG 00 01 12 04 (or a substitute form providing equivalent coverage).

The policy must also contain the following endorsement, which must be stated on the certificate of insurance:

- Contractual Liability Railroads ISO form CG 24 17 10 01 (or a substitute form providing equivalent coverage) showing "Union Pacific Railroad Company Property" as the Designated Job Site.
- Designated Construction Project(s) General Aggregate Limit ISO Form CG 25 03 03 97 (or a substitute form providing equivalent coverage) showing the project on the form schedule.

**B.** **Business Automobile Coverage** insurance. Business auto coverage written on ISO form CA 00 01 10 01 (or a substitute form providing equivalent liability coverage) with a combined single limit of not less $5,000,000 for each accident and coverage must include liability arising out of any auto (including owned, hired and non-owned autos).

The policy must contain the following endorsements, which must be stated on the certificate of insurance:

- Coverage For Certain Operations In Connection With Railroads ISO form CA 20 70 10 01 (or a substitute form providing equivalent coverage) showing "Union Pacific Property" as the Designated Job Site.
- Motor Carrier Act Endorsement - Hazardous materials clean up (MCS-90) if required by law.

**C.** **Workers' Compensation and Employers' Liability** insurance. Coverage must include but not be limited to:

- Contractor's statutory liability under the workers' compensation laws of the state where the work is being performed.
- Employers' Liability (Part B) with limits of at least $500,000 each accident, $500,000 disease policy limit $500,000 each employee.

If Contractor is self-insured, evidence of state approval and excess workers compensation coverage must be provided. Coverage must include liability arising out of the U. S. Longshoremen's and Harbor Workers' Act, the Jones Act, and the Outer Continental Shelf Land Act, if applicable.

The policy must contain the following endorsement, which must be stated on the certificate of insurance:

- Alternate Employer endorsement ISO form WC 00 03 01 A (or a substitute form providing equivalent coverage) showing Railroad in the schedule as the alternate employer (or a substitute form providing equivalent coverage).

**D.** **Railroad Protective Liability** insurance. Contractor must maintain "Railroad Protective Liability" (RPL) insurance written on ISO occurrence form CG 00 35 12 04 (or a substitute form providing equivalent coverage) on behalf of Railroad as named insured, with a limit of not less than $2,000,000 per occurrence and an aggregate of $6,000,000. The definition of "JOB LOCATION" and "WORK" on the declaration page of the policy shall refer to this Agreement and shall describe all WORK or OPERATIONS performed under this agreement." Contractor shall provide this Agreement to Contractor's insurance agent(s) and/or broker(s) and Contractor shall instruct such agent(s) and/or broker(s) to procure the insurance coverage required by this Agreement. A BINDER STATING THE POLICY IS IN PLACE MUST BE SUBMITTED TO RAILROAD BEFORE THE WORK MAY COMMENCE AND UNTIL THE ORIGINAL POLICY IS FORWARDED TO UNION PACIFIC RAILROAD. **[Ken - there is a closed quote in this paragraph but no open quote.]**

**E.** **Umbrella or Excess** insurance. If Contractor utilizes umbrella or excess policies, these policies must “follow form” and afford no less coverage than the primary policy.

**F.** **Pollution Liability** insurance**.** Pollution liability coverage must be included when the scope of the work as defined in the Agreement includes installation, temporary storage, or disposal of any "hazardous" material that is injurious in or upon land, the atmosphere, or any watercourses; or may cause bodily injury at any time.

If required, coverage may be provided in separate policy form or by endorsement to Contractors CGL or RPL. In any form coverage must be equivalent to that provided in ISO form CG 24 15 "Limited Pollution Liability Extension Endorsement" or CG 28 31 "Pollution Exclusion Amendment" with limits of at least $5,000,000 per occurrence and an aggregate limit of $10,000,000.

If the scope of work as defined in this Agreement includes the disposal of any hazardous or non-hazardous materials from the job site, Contractor must furnish to Railroad evidence of pollution legal liability insurance maintained by the disposal site operator for losses arising from the insured facility accepting the materials, with coverage in minimum amounts of $1,000,000 per loss, and an annual aggregate of $2,000,000.

**Other Requirements**

**G.** All policy(ies) required above (except worker’s compensation and employers liability) must include Railroad as “Additional Insured” using ISO Additional Insured Endorsements CG 20 26, and CA 20 48 (or substitute forms providing equivalent coverage). The coverage provided to Railroad as additional insured shall, to the extent provided under ISO Additional Insured Endorsement CG 20 26, and CA 20 48 provide coverage for Railroad’s negligence whether sole or partial, active or passive, and shall not be limited by Contractor's liability under the indemnity provisions of this Agreement.

**H.** Punitive damages exclusion, if any, must be deleted (and the deletion indicated on the

certificate of insurance), unless the law governing this Agreement prohibits all punitive damages that might arise under this Agreement.

**I.** Contractor waives all rights of recovery, and its insurers also waive all rights of subrogation of damages against Railroad and its agents, officers, directors and employees. This waiver must be stated on the certificate of insurance.

**J.** Prior to commencing the work, Contractor shall furnish Railroad with a certificate(s) of insurance, executed by a duly authorized representative of each insurer, showing compliance with the insurance requirements in this Agreement.

**K.** All insurance policies must be written by a reputable insurance company acceptable to Railroad or with a current Best's Insurance Guide Rating of A- and Class VII or better, and authorized to do business in the state where the work is being performed.

**L.** The fact that insurance is obtained by Contractor or by Railroad on behalf of Contractor will not be deemed to release or diminish the liability of Contractor, including, without limitation, liability under the indemnity provisions of this Agreement. Damages recoverable by Railroad from Contractor or any third party will not be limited by the amount of the required insurance coverage.

**EXHIBIT D**
**TO**
**CONTRACTOR'S RIGHT OF ENTRY AGREEMENT**

**MINIMUM SAFETY REQUIREMENTS**

The term "employees" as used herein refer to all employees of Contractor as well as all employees of any subcontractor or agent of Contractor.

## I. Clothing

A. All employees of Contractor will be suitably dressed to perform their duties safely and in a manner that will not interfere with their vision, hearing, or free use of their hands or feet.

Specifically, Contractor's employees must wear:

(i) Waist-length shirts with sleeves.
(ii) Trousers that cover the entire leg. If flare-legged trousers are worn, the trouser bottoms must be tied to prevent catching.
(iii) Footwear that covers their ankles and has a defined heel. Employees working on bridges are required to wear safety-toed footwear that conforms to the American National Standards Institute (ANSI) and FRA footwear requirements.

B. Employees shall not wear boots (other than work boots), sandals, canvas-type shoes, or other shoes that have thin soles or heels that are higher than normal.

C. Employees must not wear loose or ragged clothing, neckties, finger rings, or other loose jewelry while operating or working on machinery.

## II. Personal Protective Equipment

Contractor shall require its employees to wear personal protective equipment as specified by Railroad rules, regulations, or recommended or requested by the Railroad Representative.

(i) Hard hat that meets the American National Standard (ANSI) Z89.1 – latest revision. Hard hats should be affixed with Contractor's company logo or name.
(ii) Eye protection that meets American National Standard (ANSI) for occupational and educational eye and face protection, Z87.1 – latest revision. Additional eye protection must be provided to meet specific job situations such as welding, grinding, etc.
(iii) Hearing protection, which affords enough attenuation to give protection from noise levels that will be occurring on the job site. Hearing protection, in the form of plugs or muffs, must be worn when employees are within:

- 100 feet of a locomotive or roadway/work equipment
- 15 feet of power operated tools
- 150 feet of jet blowers or pile drivers

- 150 feet of retarders in use (when within 10 feet, employees must wear dual ear protection – plugs and muffs)
-

(iv) Other types of personal protective equipment, such as respirators, fall protection equipment, and face shields, must be worn as recommended or requested by the Railroad Representative.

## III. On Track Safety

Contractor is responsible for compliance with the Federal Railroad Administration's Roadway Worker Protection regulations – 49CFR214, Subpart C and Railroad's On-Track Safety rules. Under 49CFR214, Subpart C, railroad contractors are responsible for the training of their employees on such regulations. In addition to the instructions contained in Roadway Worker Protection regulations, all employees must:

(i) Maintain a distance of twenty-five (25) feet to any track unless the Railroad Representative is present to authorize movements.
(ii) Wear an orange, reflectorized workwear approved by the Railroad Representative.
(iii) Participate in a job briefing that will specify the type of On-Track Safety for the type of work being performed. Contractor must take special note of limits of track authority, which tracks may or may not be fouled, and clearing the track. Contractor will also receive special instructions relating to the work zone around machines and minimum distances between machines while working or traveling.

## IV. Equipment

A. It is the responsibility of Contractor to ensure that all equipment is in a safe condition to operate. If, in the opinion of the Railroad Representative, any of Contractor's equipment is unsafe for use, Contractor shall remove such equipment from Railroad's property. In addition, Contractor must ensure that the operators of all equipment are properly trained and competent in the safe operation of the equipment. In addition, operators must be:

- Familiar and comply with Railroad's rules on lockout/tagout of equipment.
- Trained in and comply with the applicable operating rules if operating any hy-rail equipment on-track.
- Trained in and comply with the applicable air brake rules if operating any equipment that moves rail cars or any other railbound equipment.

B. All self-propelled equipment must be equipped with a first-aid kit, fire extinguisher, and audible back-up warning device.

C. Unless otherwise authorized by the Railroad Representative, all equipment must be parked a minimum of twenty-five (25) feet from any track. Before leaving any equipment unattended, the operator must stop the engine and properly secure the equipment against movement.

D. Cranes must be equipped with three orange cones that will be used to mark the working area of the crane and the minimum clearances to overhead powerlines.

## V. General Safety Requirements

A. Contractor shall ensure that all waste is properly disposed of in accordance with applicable federal and state regulations.

B. Contractor shall ensure that all employees participate in and comply with a job briefing conducted by the Railroad Representative, if applicable. During this briefing, the Railroad Representative will specify safe work procedures, (including On-Track Safety) and the potential hazards of the job. If any employee has any

questions or concerns about the work, the employee must voice them during the job briefing. Additional job briefings will be conducted during the work as conditions, work procedures, or personnel change.

C. All track work performed by Contractor meets the minimum safety requirements established by the Federal Railroad Administration's Track Safety Standards 49CFR213.

D. All employees comply with the following safety procedures when working around any railroad track:

(i) Always be on the alert for moving equipment. Employees must always expect movement on any track, at any time, in either direction.
(ii) Do not step or walk on the top of the rail, frog, switches, guard rails, or other track components.
(iii) In passing around the ends of standing cars, engines, roadway machines or work equipment, leave at least 20 feet between yourself and the end of the equipment. Do not go between pieces of equipment of the opening is less than one car length (50 feet).
(iv) Avoid walking or standing on a track unless so authorized by the employee in charge.
(v) Before stepping over or crossing tracks, look in both directions first.
(vi) Do not sit on, lie under, or cross between cars except as required in the performance of your duties and only when track and equipment have been protected against movement.

E. All employees must comply with all federal and state regulations concerning workplace safety.

# APPLICATION – RIGHT OF ENTRY

**(Please allow 30-45 days for processing)**

1. Name of Licensee _____
*(Exact Name of the Owner of the Utility)*

State of Incorporation _____; if not incorporated, please list entity's legal status

_____

2. Address, email, phone and Fax number of Licensee

_____

Email _____ Phone _____ Fax _____

3. Name, address and phone number of individual to whom agreement is to be mailed ***if different than Item 2.***

_____

_____

4. Contact information for individual to contact in the event of questions.

_____

Email _____ Phone _____ Fax _____

5. Project site location:

_____
(City, County and State)

6. Railroad site location information:

_____
*(Railroad Mile Post, Subdivision, or any other pertinent location detail.)*

7. Time period for your project use of Railroad Company's property:

Start Date:_____ Stop Date:_____

8. Will there be any activity or equipment within 25 feet of a Railroad track in connection with this property?
( ) No ( ) Yes *(If Yes, a Flagman will be required on site at your cost.)*

9. Will there be any excavation involved?
( ) No ( ) Yes *(If Yes, include shoring plans within Railroad standards.)*

10. Purpose of your request:
*(This must be detailed & complete; attach engineering plans, shoring plans and any pertinent supporting details, including maps or prints.)*

_____

_____

_____

- Additional Fees and charges may be applicable to your request. These changes cannot be determined until your project is approved.

**UNION PACIFIC RAILROAD**
**1400 DOUGLAS STREET MS 1690**
**OMAHA NE 68179**

**AGGREGATE SURFACE COURSE FOR TEMPORARY ACCESS**
Effective : April 1, 2001 Revised: January 2, 2007

Revise Article 402.10 of the Standard Specifications to read:

"**402.10 For Temporary Access.** The contractor shall construct and maintain aggregate surface course for temporary access to private entrances, commercial entrances and roads according to Article 402.07 and as directed by the Engineer.

The aggregate surface course shall be constructed to the dimensions and grades specified below, except as modified by the plans or as directed by the Engineer.

(a) Private Entrance. The minimum width shall be 12 ft (3.6 m). The minimum compacted thickness shall be 6 in. (150 mm). The maximum grade shall be eight percent, except as required to match the existing grade.

(b) Commercial Entrance. The minimum width shall be 24 ft (7.2 m). The minimum compacted thickness shall be 9 in. (230 mm). The maximum grade shall be six percent, except as required to match the existing grade.

(c) Road. The minimum width shall be 24 ft (7.2 m). The minimum compacted thickness shall be 9 in. (230 mm). The grade and elevation shall be the same as the removed pavement, except as required to meet the grade of any new pavement constructed.

Maintaining the temporary access shall include relocating and/or regrading the aggregate surface coarse for any operation that may disturb or remove the temporary access. The same type and gradation of material used to construct the temporary access shall be used to maintain it.

When use of the temporary access is discontinued, the aggregate shall be removed and utilized in the permanent construction or disposed of according to Article 202.03."

Add the following to Article 402.12 of the Standard Specifications:

"Aggregate surface course for temporary access will be measured for payment as each for every private entrance, commercial entrance or road constructed for the purpose of temporary access. If a residential drive, commercial entrance, or road is to be constructed under multiple stages, the aggregate needed to construct the second or subsequent stages will not be measured for payment but shall be included in the cost per each of the type specified."

Revise the second paragraph of Article 402.13 of the Standard Specifications to read:

"Aggregate surface course for temporary access will be paid for at the contract unit price per each for TEMPORARY ACCESS (PRIVATE ENTRANCE), TEMPORARY ACCESS (COMMERCIAL ENTRANCE) or TEMPORARY ACCESS (ROAD).

Partial payment of the each amount bid for temporary access, of the type specified, will be paid according to the following schedule:

(a) Upon construction of the temporary access, sixty percent of the contract unit price per each, of the type constructed, will be paid.

(b) Subject to the approval of the Engineer for the adequate maintenance and removal of the temporary access, the remaining forty percent of the pay item will be paid upon the permanent removal of the temporary access."

**STORM SEWER ADJACENT TO OR CROSSING WATER MAIN**
Effective: February 1, 1996 Revised: January 1, 2007

This work consists of constructing storm sewer adjacent to or crossing a water main, at the locations shown on the plans. The material and installation requirements shall be according to the latest edition of the "Standard Specifications for Water and Sewer Main Construction in Illinois", and the applicable portions of Section 550 of the Standard Specifications; which may include concrete collars and encasing pipe with seals if required.

Pipe materials shall meet the requirements of Sections 40 and 41-2.01 of the "Standard Specifications for Water and Sewer Main Construction in Illinois", except PVC pipe will not be allowed. Ductile-Iron pipe shall meet the minimum requirements for Thickness Class 50.

Encasing of standard type storm sewer, according to the details for "Water and Sewer Separation Requirements (Vertical Separation)" in the "STANDARD DRAWINGS" Division of the "Standard Specifications for Water and Sewer Main Construction in Illinois", may be used for storm sewers crossing water mains.

Basis of Payment: This work will be paid according to Article 550.10 of the Standard Specifications, at the contract unit price per foot, except the pay item shall be STORM SEWER (WATER MAIN REQUIREMENTS), of the diameter specified.

**TRAFFIC CONTROL PLAN**
Effective: September 30, 1985 Revised: January 1, 2007

Traffic Control shall be according to the applicable sections of the Standard Specifications, the Supplemental Specifications, the "Illinois Manual on Uniform Traffic Control Devices for Streets and Highways", any special details and Highway Standards contained in the plans, and the Special Provisions contained herein.

Special attention is called to Article 107.09 of the Standard Specifications and the following Highway Standards, Details, Quality Standard for Work Zone Traffic Control Devices, Recurring Special Provisions and Special Provisions contained herein, relating to traffic control.

The Contractor shall contact the District One Bureau of Traffic at least 72 hours in advance of beginning work.

STANDARDS:

| | |
|---|---|
| 643001 | SAND MODULE IMPACT ATTENUATORS |
| 701301 | LANE CLOSURE, 2L, 2W, SHORT TIME OPERATIONS |
| 701321 | LANE CLOSURE, 2L, 2W, BRIDGE REPAIR WITH BARRIER |
| 701421 | LANE CLOSURE, MULTILANE, DAY OPERATIONS ONLY, FOR SPEEDS >= 45 MPH TO 55 MPH |
| 701451 | RAMP CLOSURE FREEWAY/EXPRESSWAY |
| 701501 | URBAN LANE CLOSURE, 2L, 2W, UNDIVIDED |
| 701601 | URBAN LANE CLOSURE, MULTILANE, 1W OR 2W WITH NONTRAVERSABLE MEDIAN |
| 701801 | SIDEWALK CORNER OR CROSSWALK CLOSURE |
| 701901 | TRAFFIC CONTROL DEVICES |
| 704001 | TEMPORARY CONCRETE BARRIER |
| 782006 | GUARDRAIL AND BARRIER WALL REFLECTOR MOUNTING DETAILS |

DETAILS:

| | |
|---|---|
| TC-08 | Entrance And Exit Ramp Closure Details |
| TC-10 | Traffic Control and Protection for Side Roads, Intersections, and Driveways |
| TC-11 | Typical Applications Raised Reflective Pavement Markers (Snow Plow Resistant) |
| TC-13 | District One Typical Pavement Markings |
| TC-16 | Pavement Marking Letters and Symbols for Traffic Staging |
| TC-17 | Traffic Control Details for Freeway Shoulder Closures and Partial Ramp Closures |
| TC-21 | Detour Signing for Closing State Highways |
| TC-22 | Arterial Road Information Sign |
| TC-26 | Driveway Entrance Signing |

SPECIAL PROVISIONS:

AGGREGATE SURFACE COURSE FOR TEMPORARY ACCESS (D-1)
KEEPING ARTERIAL ROADWAYS OPEN TO TRAFFIC (LANE CLOSURES ONLY) (D-1)
LIGHTS ON BARRICADES (BDE)
MAINTENANCE OF ROADWAYS (D-1)
TEMPORARY INFORMATION SIGNING (D-1)
TEMPORARY PAVEMENT (D-1)
TEMPORARY PAVEMENT MARKING (BDE)
TEMPORARY PORTABLE BRIDGE TRAFFIC SIGNALS (Recurring)
TRAFFIC CONTROL DEVICES – CONES (BDE)
TRAFFIC CONTROL PLAN (D-1)
TRAFFIC SPOTTERS (BDE)

**AGGREGATE SUBGRADE IMPROVEMENT (D-1)**
Effective February 22, 2012 Revised: April 1, 2016

Add the following Section to the Standard Specifications:

"**SECTION 303. AGGREGATE SUBGRADE IMPROVEMENT**

**303.01 Description.** This work shall consist of constructing an aggregate subgrade improvement.

**303.02 Materials.** Materials shall be according to the following.

| Item | Article/Section |
|---|---|
| (a) Coarse Aggregate | 1004.07 |
| (b) Reclaimed Asphalt Pavement (RAP) (Notes 1, 2 and 3) | 1031 |

Note 1. Crushed RAP, from either full depth or single lift removal, may be mechanically blended with aggregate gradation CS 01 but shall not exceed 40 percent by weight of the total product. The top size of the Coarse RAP shall be less than 4 in. (100 mm) and well graded.

Note 2. RAP having 100 percent passing the 1 1/2 in (37.5 mm) sieve and being well graded, may be used as capping aggregate in the top 3 in. (75 mm) when aggregate gradation CS 01 is used in lower lifts. When RAP is blended with any of the coarse aggregates, the blending shall be done with mechanically calibrated feeders. The final product shall not contain more than 40 percent by weight of RAP.

Note 3. The RAP used for aggregate subgrade improvement shall be according to the current Bureau of Materials and Physical Research Policy Memorandum, "Reclaimed Asphalt Pavement (RAP) for Aggregate Applications".

**303.03 Equipment.** The vibratory machine shall be according to Article 1101.01, or as approved by the Engineer. The calibration for the mechanical feeders shall have an accuracy of ± 2.0 percent of the actual quantity of material delivered.

**303.04 Soil Preparation.** The stability of the soil shall be according to the Department's Subgrade Stability Manual for the aggregate thickness specified.

**303.05 Placing Aggregate.** The maximum nominal lift thickness of aggregate gradation CS 01 shall be 24 in. (600 mm).

**303.06 Capping Aggregate.** The top surface of the aggregate subgrade shall consist of a minimum 3 in. (75 mm) of aggregate gradations CA 06 or CA 10. When Reclaimed Asphalt Pavement (RAP) is used, it shall be crushed and screened where 100 percent is passing the 1 1/2 in. (37.5 mm) sieve and being well graded. RAP that has been fractionated to size will not be permitted for use in capping. Capping aggregate will not be required when the aggregate subgrade improvement is used as a cubic yard pay item for undercut applications. When RAP is blended with any of the coarse aggregates, the blending shall be done with mechanically calibrated feeders.

**303.07 Compaction.** All aggregate lifts shall be compacted to the satisfaction of the Engineer. If the moisture content of the material is such that compaction cannot be obtained, sufficient water shall be added so that satisfactory compaction can be obtained.

**303.08 Finishing and Maintenance of Aggregate Subgrade Improvement.** The aggregate subgrade improvement shall be finished to the lines, grades, and cross sections shown on the plans, or as directed by the Engineer. The aggregate subgrade improvement shall be maintained in a smooth and compacted condition.

**303.09 Method of Measurement.** This work will be measured for payment according to Article 311.08.

**303.10 Basis of Payment.** This work will be paid for at the contract unit price per cubic yard (cubic meter) for AGGREGATE SUBGRADE IMPROVEMENT or at the contract unit price per square yard (square meter) for AGGREGATE SUBGRADE IMPROVEMENT, of the thickness specified.

Add the following to Section 1004 of the Standard Specifications:

"**1004.07 Coarse Aggregate for Aggregate Subgrade Improvement.** The aggregate shall be according to Article 1004.01 and the following.

(a) Description. The coarse aggregate shall be crushed gravel, crushed stone, or crushed concrete. The top 12 inches of the aggregate subgrade improvement shall be 3 inches of capping material and 9 inches of crushed gravel, crushed stone or crushed concrete. In applications where greater than 36 inches of subgrade material is required, rounded gravel, meeting the CS01 gradation, may be used beginning at a depth of 12 inches below the bottom of pavement.

(b) Quality. The coarse aggregate shall consist of sound durable particles reasonably free of deleterious materials. Non-mechanically blended RAP may be allowed up to a maximum of 5.0 percent.

(c) Gradation.

(1) The coarse aggregate gradation for total subgrade thicknesses of 12 in. (300 mm) or greater shall be CS 01.

| Grad No. | COARSE AGGREGATE SUBGRADE GRADATIONS Sieve Size and Percent Passing | | | | |
|---|---|---|---|---|---|
| | 8" | 6" | 4" | 2" | #4 |
| CS 01 | 100 | 97 ± 3 | 90 ± 10 | 45 ± 25 | 20 ± 20 |

| Grad No. | COARSE AGGREGATE SUBGRADE GRADATIONS (Metric) | | | | |
|---|---|---|---|---|---|
| | Sieve Size and Percent Passing | | | | |
| | 200 mm | 150 mm | 100 mm | 50 mm | 4.75 mm |
| CS 01 | 100 | 97 ± 3 | 90 ± 10 | 45 ± 25 | 20 ± 20 |

(2) The 3 in. (75 mm) capping aggregate shall be gradation CA 6 or CA 10.

**DRAINAGE AND INLET PROTECTION UNDER TRAFFIC (DISTRICT 1)**
Effective: April 1, 2011 Revised: April 2, 2011

Add the following to Article 603.02 of the Standard Specifications:

"(i) Temporary Hot-Mix Asphalt (HMA) Ramp (Note 1) ……. .....1030
(j) Temporary Rubber Ramps (Note 2)

Note 1. The HMA shall have maximum aggregate size of 3/8 in. (95 mm).

Note 2. The rubber material shall be according to the following.

| Property | Test Method | Requirement |
|---|---|---|
| Durometer Hardness, Shore A | ASTM D 2240 | 75 ±15 |
| Tensile Strength, psi (kPa) | ASTM D 412 | 300 (2000) min |
| Elongation, percent | ASTM D 412 | 90 min |
| Specific Gravity | ASTM D 792 | 1.0 - 1.3 |
| Brittleness, °F (°C) | ASTM D 746 | -40 (-40)" |

Revise Article 603.07 of the Standard Specifications to read:

"**603.07 Protection Under Traffic.** After the casting has been adjusted and the Class PP concrete has been placed, the work shall be protected by a barricade and two lights according to Article 701.17(e)(3)b.

When castings are under traffic before the final surfacing operation has been started, properly sized temporary ramps shall be placed around the drainage and/or utility castings according to the following methods.

(a) Temporary Asphalt Ramps. Temporary hot-mix asphalt ramps shall be placed around the casting, flush with its surface and decreasing to a featheredge in a distance of 2 ft (600 mm) around the entire surface of the casting.

(b) Temporary Rubber Ramps. Temporary rubber ramps shall only be used on roadways with permanent posted speeds of 40 mph or less and when the height of the casting to be protected meets the proper sizing requirements for the rubber ramps as shown below.

| Dimension | Requirement |
|---|---|
| Inside Opening | Outside dimensions of casting + 1 in. (25 mm) |
| Thickness at inside edge | Height of casting ± 1/4 in. (6 mm) |
| Thickness at outside edge | 1/4 in. (6 mm) max. |
| Width, measured from inside opening to outside edge | 8 1/2 in. (215 mm) min |

Placement shall be according to the manufacturer's specifications.

Temporary ramps for castings shall remain in place until surfacing operations are undertaken within the immediate area of the structure. Prior to placing the surface course, the temporary ramp shall be removed. Excess material shall be disposed of according to Article 202.03."

**ENGINEER'S FIELD OFFICE TYPE A (SPECIAL)**
Effective: December 1, 2011 Revised: May 1, 2013

Revise the first paragraph of Article 670.02 to read:

**670.02 Engineer's Field Office Type A (Special).** Type A (Special) field offices shall have a ceiling height of not less than 7 feet and a floor space of not less than 3000 square feet with a minimum of two separate offices. The office shall also have a separate storage room capable of being locked for the storage of the nuclear measuring devices. The office shall be provided with sufficient heat, natural and artificial light, and air conditioning. Doors and windows shall be equipped with locks approved by the Engineer.

Revise the first sentence of the second paragraph of Article 670.02 to read:

An electronic security system that will respond to any breach of exterior doors and windows with an on-site alarm shall be provided.

Revise the last sentence of the third paragraph of Article 670.02 to read:

Adequate all-weather parking space shall be available to accommodate a minimum of twelve vehicles.

Revise the fifth paragraph of Article 670.02 to read:

Sanitary facilities shall include hot and cold potable running water, lavatory and toilet as an integral part of the office where available. Solid waste disposal consisting of seven waste baskets and an outside trash container of sufficient size to accommodate a weekly provided pick-up service.Add the following to the f A weekly cleaning service for the office shall be provided.

Revise subparagraph (a) of Article 670.02 to read:

(a) Twelve desks with minimum working surface 42 inch x 30 inch each and twelve non-folding chairs with upholstered seats and backs.

Revise the first sentence of subparagraph (c) of Article 670.02 to read:

(c) Two four-post drafting tables with minimum top size of 37-½ inch x 48 inch.

Revise subparagraph (d) of Article 670.02 to read:

(d) Eight free standing four-drawer legal size file cabinets with lock and an underwriters' laboratories insulated file device 350 degrees one hour rating.

Revise subparagraph (e) of Article 670.02 to read:

(e) Twenty folding chairs and two conference tables with minimum top size of 44 inch x 96 inch.

Revise subparagraph (h) of Article 670.02 to read:

(h) Three electric desk type tape printing calculator and two pocket scientific notation calculators with a 1000 hour battery life or with a portable recharger.

Revise subparagraph (i)(2) of Article 670.02 to read:

(i)(2) Telephones lines. Five separate telephone lines including one line for the fax machine, and two lines for the exclusive use of the Engineer. All telephone lines shall include long distance service and all labor and materials necessary to install the phone lines at the locations directed by the Engineer. The TELCOM company shall configure ROLL/HUNT features as specified by the engineer.

Revise subparagraph (j) of Article 670.02 to read:

(j) Two plain paper network multi-function printer/copier/scanner machines capable of reproducing prints up to 11 inch x 17 inch within automatic feed tray capable of sorting 30 sheets of paper. Letter size and 11 inch x 17 inch paper shall be provided. The contractor shall provide the multi-function machines with IT support for setup and maintenance.

Revise subparagraph (k) of Article 670.02 to read:

(k) One plain paper fax machine including maintenance and supplies.

Revise subparagraph (l) of Article 670.02 to read:

(l) Six four-line telephones, with touch tone, where available, and two digital answering machines, for exclusive use by the Engineer.

Revise subparagraph (m) of Article 670.02 to read:

(m) One electric water cooler dispenser including water service.

Add the following subparagraphs to Article 670.02:

(s) One 4 foot x 6 foot chalkboard or dry erase board.

(t) One 4 foot x 6 foot framed cork board.

Add the following to Article 670.07 Basis of Payment.

The building or buildings, fully equipped, will be paid for at the contract unit price per calendar month or fraction thereof for ENGINEER'S FIELD OFFICE, TYPE A (SPECIAL).

**FRICTION AGGREGATE (D-1)**
Effective: January 1, 2011 Revised: April 29, 2016

Revise Article 1004.03(a) of the Standard Specifications to read:

"**1004.03 Coarse Aggregate for Hot-Mix Asphalt (HMA).** The aggregate shall be according to Article 1004.01 and the following.

(a) Description. The coarse aggregate for HMA shall be according to the following table.

| Use | Mixture | Aggregates Allowed |
|---|---|---|
| Class A | Seal or Cover | Allowed Alone or in Combination [5/]:<br>Gravel<br>Crushed Gravel<br>Carbonate Crushed Stone<br>Crystalline Crushed Stone<br>Crushed Sandstone<br>Crushed Slag (ACBF)<br>Crushed Steel Slag<br>Crushed Concrete |
| HMA<br>Low ESAL | Stabilized Subbase or Shoulders | Allowed Alone or in Combination [5/]:<br>Gravel<br>Crushed Gravel<br>Carbonate Crushed Stone<br>Crystalline Crushed Stone<br>Crushed Sandstone<br>Crushed Slag (ACBF)<br>Crushed Steel Slag[1/]<br>Crushed Concrete |
| HMA<br>High ESAL<br>Low ESAL | Binder<br>IL-19.0<br>or IL-19.0L<br><br>SMA Binder | Allowed Alone or in Combination [5/ 6/]:<br>Crushed Gravel<br>Carbonate Crushed Stone[2/]<br>Crystalline Crushed Stone<br>Crushed Sandstone<br>Crushed Slag (ACBF)<br>Crushed Concrete[3/] |
| HMA<br>High ESAL<br>Low ESAL | C Surface and Leveling Binder<br>IL-9.5 or IL-9.5L<br><br>SMA<br>Ndesign 50<br>Surface | Allowed Alone or in Combination [5/]:<br>Crushed Gravel<br>Carbonate Crushed Stone[2/]<br>Crystalline Crushed Stone<br>Crushed Sandstone<br>Crushed Slag (ACBF)<br>Crushed Steel Slag[4/]<br>Crushed Concrete[3/] |

<table>
<tr><th>Use</th><th>Mixture</th><th colspan="2">Aggregates Allowed</th></tr>
<tr><td rowspan="5">HMA<br>High ESAL</td><td rowspan="5">D Surface and Leveling Binder<br>IL-9.5<br><br>SMA<br>Ndesign 50<br>Surface</td><td colspan="2"><u>Allowed Alone or in Combination</u> [5/]:<br>Crushed Gravel<br>Carbonate Crushed Stone (other than Limestone)[2/]<br>Crystalline Crushed Stone<br>Crushed Sandstone<br>Crushed Slag (ACBF)<br>Crushed Steel Slag[4/]<br>Crushed Concrete[3/]</td></tr>
<tr><td colspan="2"><u>Other Combinations Allowed:</u></td></tr>
<tr><td>Up to...</td><td>With...</td></tr>
<tr><td>25% Limestone</td><td>Dolomite</td></tr>
<tr><td>50% Limestone</td><td>Any Mixture D aggregate other than Dolomite</td></tr>
<tr><td rowspan="5">HMA<br>High ESAL</td><td rowspan="5">E Surface<br>IL-9.5<br><br>SMA<br>Ndesign 80<br>Surface</td><td colspan="2"><u>Allowed Alone or in Combination</u> [5/ 6/]:<br><br>Crystalline Crushed Stone<br>Crushed Sandstone<br>Crushed Slag (ACBF)<br>Crushed Steel Slag<br><br>No Limestone.</td></tr>
<tr><td colspan="2"><u>Other Combinations Allowed:</u></td></tr>
<tr><td>Up to...</td><td>With...</td></tr>
<tr><td>50% Dolomite[2/]</td><td>Any Mixture E aggregate</td></tr>
<tr><td>75% Dolomite[2/]</td><td>Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone</td></tr>
<tr><td>75% Crushed Gravel[2/] or Crushed Concrete[3/]</td><td>Crushed Sandstone, Crystalline Crushed Stone, Crushed Slag (ACBF), or Crushed Steel Slag</td></tr>
</table>

<table>
<tr><td>Use</td><td>Mixture</td><td colspan="2">Aggregates Allowed</td></tr>
<tr><td rowspan="3">HMA<br>High ESAL</td><td rowspan="3">F Surface<br>IL-9.5<br><br>SMA<br>Ndesign 80<br>Surface</td><td colspan="2"><u>Allowed Alone or in Combination</u> [5/ 6/]:<br><br>Crystalline Crushed Stone<br>Crushed Sandstone<br>Crushed Slag (ACBF)<br>Crushed Steel Slag<br>No Limestone.</td></tr>
<tr><td colspan="2"><u>Other Combinations Allowed</u>:</td></tr>
<tr><td>Up to...</td><td>With...</td></tr>
<tr><td>50% Crushed Gravel[2/], Crushed Concrete[3/], or Dolomite[2/]</td><td>Crushed Sandstone, Crushed Slag (ACBF), Crushed Steel Slag, or Crystalline Crushed Stone</td></tr>
</table>

1/ Crushed steel slag allowed in shoulder surface only.
2/ Carbonate crushed stone (limestone) and/or crushed gravel shall not be used in SMA Ndesign 80. In SMA Ndesign 50, carbonate crushed stone shall not be blended with any of the other aggregates allowed alone in Ndesign 50 SMA binder or Ndesign 50 SMA surface.
3/ Crushed concrete will not be permitted in SMA mixes.
4/ Crushed steel slag shall not be used as leveling binder.
5/ When combinations of aggregates are used, the blend percent measurements shall be by volume."
6/ Combining different types of aggregate will not be permitted in SMA Ndesign 80."

**GROUND TIRE RUBBER (GTR) MODIFIED ASPHALT BINDER (D-1)**
Effective: June 26, 2006 Revised: April 1, 2016

Add the following to the end of article 1032.05 of the Standard Specifications:

"(c) Ground Tire Rubber (GTR) Modified Asphalt Binder. A quantity of 10.0 to 14.0 percent GTR (Note 1) shall be blended by dry unit weight with a PG 64-28 to make a GTR 70-28 or a PG 58-28 to make a GTR 64-28. The base PG 64-28 and PG 58-28 asphalt binders shall meet the requirements of Article 1032.05(a). Compatible polymers may be added during production. The GTR modified asphalt binder shall meet the requirements of the following table.

| Test | Asphalt Grade GTR 70-28 | Asphalt Grade GTR 64-28 |
|---|---|---|
| Flash Point (C.O.C.), AASHTO T 48, °F (°C), min. | 450 (232) | 450 (232) |
| Rotational Viscosity, AASHTO T 316 @ 275 °F (135 °C), Poises, Pa·s, max. | 30 (3) | 30 (3) |
| Softening Point, AASHTO T 53, °F (°C), min. | 135 (57) | 130 (54) |
| Elastic Recovery, ASTM D 6084, Procedure A (sieve waived) @ 77 °F, (25 °C), aged, ss, 100 mm elongation, 5 cm/min., cut immediately, %, min. | 65 | 65 |

Note 1. GTR shall be produced from processing automobile and/or light truck tires by the ambient grinding method. GTR shall not exceed 1/16 in. (2 mm) in any dimension and shall contain no free metal particles or other materials. A mineral powder (such as talc) meeting the requirements of AASHTO M 17 may be added, up to a maximum of four percent by weight of GTR to reduce sticking and caking of the GTR particles. When tested in accordance with Illinois modified AASHTO T 27, *a* 50 g sample of the GTR shall conform to the following gradation requirements:

| Sieve Size | Percent Passing |
|---|---|
| No. 16 (1.18 mm) | 100 |
| No. 30 (600 µm) | 95 ± 5 |
| No. 50 (300 µm) | > 20 |

Add the following to the end of Note 1. of article 1030.03 of the Standard Specifications:

"A dedicated storage tank for the Ground Tire Rubber (GTR) modified asphalt binder shall be provided. This tank must be capable of providing continuous mechanical mixing throughout by continuous agitation and recirculation of the asphalt binder to provide a uniform mixture. The tank shall be heated and capable of maintaining the temperature of the asphalt binder at 300 °F to 350 °F (149 °C to 177 °C). The asphalt binder metering systems of dryer drum plants shall be calibrated with the actual GTR modified asphalt binder material with an accuracy of ± 0.40 percent."

Revise 1030.02(c) of the Standard Specifications to read:

"(c) RAP Materials (Note 5) ……..…..1031"

Add the following note to 1030.02 of the Standard Specifications:

Note 5. When using reclaimed asphalt pavement and/or reclaimed asphalt shingles, the maximum asphalt binder replacement percentage shall be according to the most recent special provision for recycled materials.

**HOT-MIX ASPHALT – MIXTURE DESIGN VERIFICATION AND PRODUCTION (MODIFIED FOR I-FIT DATA COLLECTION) (D-1)**
Effective: January 3, 2020

Description. This special provision requires the Illinois Flexibility Index Test (I-FIT) be used during mixture design verification and production testing for all hot-mix asphalt (HMA) mixtures.

Mixture Design. Add the following to the list of referenced standards in Article 1030.04 of the Standard Specifications:

"Illinois Modified AASHTO TP 124 Determining the Fracture Potential of Asphalt Mixtures Using the Illinois Flexibility Index Test (I-FIT)"

Add to Article 1030.04(d) of the Standard Specifications :

"During mixture design, prepared samples shall be submitted to the District laboratory for verification testing. The required testing, and number and size of prepared samples submitted, shall be according to the following tables.

| High ESAL – Required Samples for Verification Testing [1/] | |
|---|---|
| Mixture | I-FIT Testing |
| Binder | total of 3 - 160 mm tall bricks [2/] |
| Surface | total of 4 - 160 mm tall bricks [2/] |

| Low ESAL – Required Samples for Verification Testing [1/] | |
|---|---|
| Mixture | I-FIT Testing |
| Binder | 1 - 160 mm tall brick [2/] |
| Surface | 2 - 160 mm tall bricks [2/] |

1/Prepared samples shall be compacted gyratory bricks yielding test specimens with 7.0 ± 1.0% air voids.

2/If the Contractor does not possess the equipment to prepare the 160 mm tall brick(s), twice as many 115 mm tall compacted gyratory bricks will be acceptable.

Add the following to Article 1030.04 (d) of Standard Specification to read:

(3) I-FIT Flexibility Index (FI) Criteria. I-FIT testing will be according to Illinois Modified AASHTO TP 124 and the results will be for informational purposes only.

Add the following to Article 1030.06 (a) of the Standard Specifications to read:

An I-FIT shall be conducted on all HMA mixtures from a sample taken within the first 500 tons (450 metric tons) on the first day of production or during start up with an 80 lb (36 kg) split reserved for the Department. The mix sample shall be tested according to the Illinois Modified ASSHTO TP 124 Determining the Fracture Potential of Asphalt Mixtures Using the Illinois Flexibility Index Test (I-FIT). Within two working days after sampling, the Contractor shall deliver prepared samples to the District laboratory for verification testing. The required number and size of prepared samples submitted for the I-FIT testing shall be according to the "High ESAL - Required Samples for Verification Testing" table in Article 1030.04(d) above.

Mixture sampled during production for I-FIT will be tested by the Department.

Add the following to the end of Article 1030.06(b) of the Standard Specifications:

"I-FIT testing will be performed for Low ESAL mixtures (excluding Class D patches, pavement patching and incidental HMA) during mixture production. Within two working day after sampling, the Contractor shall deliver prepared samples to the District laboratory for verification testing. The required number and size of prepared samples submitted for the I-FIT testing shall be according to the "Low ESAL - Required Samples for Verification Testing" table in Article 1030.04(d) above."

**HOT-MIX ASPHALT BINDER AND SURFACE COURSE (D-1)**
Effective: November 1, 2019 Revised: February 1, 2020

Description. This work shall consist of constructing a hot-mix asphalt (HMA) binder and/or surface course on a prepared base. Work shall be according to Sections 406 and 1030 of the Standard Specifications, except as modified herein.

Materials. Revise Article 1004.03(c) to read:

" (c) Gradation. The coarse aggregate gradations shall be as listed in the following table.

| Use | Size/Application | Gradation No. |
|---|---|---|
| Class A-1, A-2, & A-3 | 3/8 in. (10 mm) Seal | CA 16 or CA 20 |
| Class A-1 | 1/2 in. (13 mm) Seal | CA 15 |
| Class A-2 & A-3 | Cover Coat | CA 14 |
| HMA High ESAL | IL-19.0;<br>Stabilized Subbase IL-19.0 | CA 11 1/ |
| | SMA 12.5 2/ | CA 13 4/, CA 14, or CA 16 |
| | SMA 9.5 2/ | CA 13 3/4/ or CA 16 3/ |
| | IL-9.5 | CA 16 |
| | IL-9.5FG | CA 16 |
| HMA Low ESAL | IL-19.0L | CA 11 1/ |
| | IL-9.5L | CA 16 |

1/ CA 16 or CA 13 may be blended with the CA 11.

2/ The coarse aggregates used shall be capable of being combined with stone sand, slag sand, or steel slag sand meeting the FA/FM 20 gradation and mineral filler to meet the approved mix design and the mix requirements noted herein.

3/ The specified coarse aggregate gradations may be blended.

4/ CA 13 shall be 100 percent passing the 1/2 in. (12.5mm) sieve."

Revise Article 1004.03(e) of the Supplemental Specifications to read:

"(e) Absorption. For SMA the coarse aggregate shall also have water absorption ≤ 2.0 percent."

HMA Nomenclature. Revise the "High ESAL" portion of the table in Article 1030.01 to read:

| | | |
|---|---|---|
| "High ESAL | Binder Courses | IL-19.0, IL-9.5, IL-9.5FG,<br>IL-4.75, SMA 12.5,<br>Stabilized Subbase IL-19.0 |
| | Surface Courses | IL-9.5, IL-9.5FG,<br>SMA 12.5, SMA 9.5" |

Revise Article 1030.02 of the Standard Specifications and Supplemental Specifications to read:

"**1030.02 Materials.** Materials shall be according to the following.

| Item | Article/Section |
|---|---|
| (a) Coarse Aggregate | 1004.03 |
| (b) Fine Aggregate | 1003.03 |
| (c) RAP Material | 1031 |
| (d) Mineral Filler | 1011 |
| (e) Hydrated Lime | 1012.01 |
| (f) Slaked Quicklime (Note 1) | |
| (g) Performance Graded Asphalt Binder (Note 2) | 1032 |
| (h) Fibers (Note 3) | |
| (i) Warm Mix Asphalt (WMA) Technologies (Note 4) | |

Note 1. Slaked quicklime shall be according to ASTM C 5.

Note 2. The asphalt binder shall be an SBS PG 76-28 when the SMA is used on a full-depth asphalt pavement and SBS PG 76-22 when used as an overlay, except where modified herein. The asphalt binder shall be a SBS PG 76-22 for IL-4.75, except where modified herein. The elastic recovery shall be a minimum of 80.

Note 3. A stabilizing additive such as cellulose or mineral fiber shall be added to the SMA mixture according to Illinois Modified AASHTO M 325. The stabilizing additive shall meet the Fiber Quality Requirements listed in Illinois Modified AASHTO M 325. Prior to approval and use of fibers, the Contractor shall submit a notarized certification by the producer of these materials stating they meet these requirements. Reclaimed Asphalt Shingles (RAS) may be used in Stone Matrix Asphalt (SMA) mixtures designed with an SBA polymer modifier as a fiber additive if the mix design with RAS included meets AASHTO T305 requirements. The RAS shall be from a certified source that produces either Type I or Type 2. Material shall meet requirements noted herein and the actual dosage rate will be determined by the Engineer.

Note 4. Warm mix additives or foaming processes shall be selected from the Department's Qualified Producer List, "Technologies for the Production of Warm Mix Asphalt (WMA)"."

Mixture Design. Revise Article 1030.04(a)(1) of the Standard Specifications and the Supplemental Specifications to read:

| High ESAL, MIXTURE COMPOSITION (% PASSING) [1/] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sieve Size | IL-19.0 mm | | SMA 12.5 | | SMA 9.5 | | IL-9.5mm | | IL-4.75 mm | |
| | min | max | min | max | min | max | min | max | min | max |
| 1 1/2 in (37.5 mm) | | | | | | | | | | |
| 1 in. (25 mm) | | 100 | | | | | | | | |
| 3/4 in. (19 mm) | 90 | 100 | | 100 | | | | | | |
| 1/2 in. (12.5 mm) | 75 | 89 | 80 | 100 | | 100 | | 100 | | 100 |
| 3/8 in. (9.5 mm) | | | | 65 | 90 | 100 | 90 | 100 | | 100 |
| #4 (4.75 mm) | 40 | 60 | 20 | 30 | 36 | 50 | 34 | 69 | 90 | 100 |
| #8 (2.36 mm) | 20 | 42 | 16 | 24 [4/] | 16 | 32[4/] | 34 [5/] | 52 [2/] | 70 | 90 |
| #16 (1.18 mm) | 15 | 30 | | | | | 10 | 32 | 50 | 65 |
| #30 (600 µm) | | | 12 | 16 | 12 | 18 | | | | |
| #50 (300 µm) | 6 | 15 | | | | | 4 | 15 | 15 | 30 |
| #100 (150 µm) | 4 | 9 | | | | | 3 | 10 | 10 | 18 |
| #200 (75 µm) | 3 | 6 | 7.0 | 9.0 [3/] | 7.5 | 9.5 [3/] | 4 | 6 | 7 | 9 [3/] |
| #635 (20 µm) | | | ≤ 3.0 | | ≤ 3.0 | | | | | |
| Ratio Dust/Asphalt Binder | | 1.0 | | 1.5 | | 1.5 | | 1.0 | | 1.0 |

1/ Based on percent of total aggregate weight.

2/ The mixture composition shall not exceed 44 percent passing the #8 (2.36 mm) sieve for surface courses with Ndesign = 90.

3/ Additional minus No. 200 (0.075 mm) material required by the mix design shall be mineral filler, unless otherwise approved by the Engineer.

4/ When establishing the Adjusted Job Mix Formula (AJMF) the percent passing the #8 (2.36 mm) sieve shall not be adjusted above the percentage stated on the table.

5/ When establishing the Adjusted Job Mix Formula (AJMF) the percent passing the #8 (2.36 mm) sieve shall not be adjusted below 34 percent.

Revise Article 1030.04(b)(1) of the Standard Specifications to read:

"(1) High ESAL Mixtures. The target value for the air voids of the HMA shall be 4.0 percent, for IL-4.75 it shall be 3.5 percent and for Stabilized Subbase it shall be 3.0 percent at the design number of gyrations. The voids in the mineral aggregate (VMA) and voids filled with asphalt binder (VFA) of the HMA design shall be based on the nominal maximum size of the aggregate in the mix and shall conform to the following requirements.

| VOLUMETRIC REQUIREMENTS<br>High ESAL | | | | |
|---|---|---|---|---|
| | Voids in the Mineral Aggregate (VMA),<br>% minimum | | | Voids Filled with Asphalt Binder (VFA),<br>% |
| Ndesign | IL-19.0;<br>Stabilized Subbase<br>IL- 19.0 | IL-9.5 | IL-4.75[1/] | |
| 50 | 13.5 | 15.0 | 18.5 | 65 – 78 [2/] |
| 70 | | | | 65 - 75 |
| 90 | | | | |

1/ Maximum draindown for IL-4.75 shall be 0.3 percent.

2/ VFA for IL-4.75 shall be 72-85 percent."

Revise the table in Article 1030.04(b)(3) to read:

| "VOLUMETRIC REQUIREMENTS, SMA 12.5 [1/] and SMA 9.5 [1/] | | | |
|---|---|---|---|
| Ndesign | Design Air Voids Target % | Voids in the Mineral Aggregate (VMA), % min. | Voids Filled with Asphalt (VFA), % |
| 80 [4/] | 3.5 | 17.0 [2/] | 75 - 83 |
| | | 16.0 [3/] | |

1/ Maximum draindown shall be 0.3 percent. The draindown shall be determined at the JMF asphalt binder content at the mixing temperature plus 30 °F.

2/ Applies when specific gravity of coarse aggregate is ≥ 2.760.

3/ Applies when specific gravity of coarse aggregate is < 2.760.

4/ Blending of different types of aggregate will not be permitted.
For surface course, the coarse aggregate can be crushed steel slag, crystalline crushed stone or crushed sandstone. For binder course, coarse aggregate shall be crushed stone (dolomite), crushed gravel, crystalline crushed stone, or crushed sandstone.

Add to the end of Article 1030.05 (d) (2) a. of the Standard Specifications:

"During production, the Contractor shall test SMA mixtures for draindown according to AASHTO T305 at a frequency of 1 per day of production."

Revise the last paragraph of Article 1102.01 (a) (5) of the Standard Specifications to read:

"IL-4.75 and Stone Matrix Asphalt (SMA) mixtures which contain aggregate having absorptions greater than or equal to 2.0 percent, or which contain steal slag sand, shall have minimum surge bin storage plus haul time of 1.5 hours."

Quality Control/Quality Assurance (QC/QA). Revise the third paragraph of Article 1030.05(d)(3) to read:

"If the Contractor and Engineer agree the nuclear density test method is not appropriate for the mixture, cores shall be taken at random locations determined according to the QC/QA document "Determination of Random Density Test Site Locations". Core densities shall be determined using the Illinois Modified AASHTO T 166 or T 275 procedure."

Add the following paragraphs to the end of Article 1030.05(d)(3):

"Longitudinal joint density testing shall be performed at each random density test location. Longitudinal joint testing shall be located at a distance equal to the lift thickness or a minimum of 4 in. (100 mm), from each pavement edge (i.e. for a 5 in. (125 mm) lift the near edge of the density gauge or core barrel shall be within 5 in. (125 mm) from the edge of pavement). Longitudinal joint density testing shall be performed using either a correlated nuclear gauge or cores.

a. Confined Edge. Each confined edge density shall be represented by a one-minute nuclear density reading or a core density and shall be included in the average of density readings or core densities taken across the mat which represents the Individual Test.

b. Unconfined Edge. Each unconfined edge joint density shall be represented by an average of three one-minute density readings or a single core density at the given density test location and shall meet the density requirements specified herein. The three one-minute readings shall be spaced 10 ft (3 m) apart longitudinally along the unconfined pavement edge and centered at the random density test location.

When a longitudinal joint sealant (LJS) is applied, longitudinal joint density testing will not be required on the joint(s) sealed."

Revise the second table in Article 1030.05(d)(4) and its notes to read:

| "DENSITY CONTROL LIMITS | | | |
|---|---|---|---|
| Mixture Composition | Parameter | Individual Test (includes confined edges) | Unconfined Edge Joint Density, minimum |
| IL-4.75 | Ndesign = 50 | 93.0 – 97.4 % 1/ | 91.0% |
| IL-9.5FG | Ndesign = 50 - 90 | 93.0 – 97.4 % | 91.0% |
| IL-9.5 | Ndesign = 90 | 92.0 – 96.0 % | 90.0% |
| IL-9.5, IL-9.5L, | Ndesign < 90 | 92.5 – 97.4 % | 90.0% |
| IL-19.0 | Ndesign = 90 | 93.0 – 96.0 % | 90.0% |
| IL-19.0, IL-19.0L | Ndesign < 90 | 93.0 2/ – 97.4 % | 90.0% |
| SMA | Ndesign = 80 | 93.5 – 97.4 % | 91.0% |

1/ Density shall be determined by cores or by correlated, approved thin lift nuclear gauge.

2/ 92.0 % when placed as first lift on an unimproved subgrade."

Equipment. Add the following to Article 1101.01 of the Standard Specifications:

"(h) Oscillatory Roller. The oscillatory roller shall be self-propelled and provide a smooth operation when starting, stopping, or reversing directions. The oscillatory roller shall be able to operate in a mode that will provide tangential impact force with or without vertical impact force by using at least one drum. The oscillatory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the drums to prevent material pickup. The drum(s) amplitude and frequency of the tangential and vertical impact force shall be approximately the same in each direction and meet the following requirements:

(1) The minimum diameter of the drum(s) shall be 42 in. (1070 mm);

(2) The minimum length of the drum(s) shall be 57 in. (1480 mm);

(3) The minimum unit static force on the drum(s) shall be 125 lb/in. (22 N/m); and

(4) The minimum force on the oscillatory drum shall be 18,000 lb (80 kN)."

Construction Requirements.

Add the following to Article 406.03 of the Standard Specifications:

"(j) Oscillatory Roller .....1101.01"

Revise the third paragraph of Article 406.05(a) to read:

"All depressions of 1 in. (25 mm) or more in the surface of the existing pavement shall be filled with binder. At locations where heavy disintegration and deep spalling exists, the area shall be cleaned of all loose and unsound material, tacked, and filled with binder (hand method)."

Revise Article 406.05(c) to read.

"(c) Binder (Hand Method). Binder placed other than with a finishing machine will be designated as binder (hand method) and shall be compacted with a roller to the satisfaction of the Engineer. Hand tamping will be permitted when approved by the Engineer."

Revise the special conditions for mixture IL-4.75 in Article 406.06(b)(2)e. to read:

"e. The mixture shall be overlaid within 5 days of being placed."

Revise Article 406.06(d) to read:

"(d) Lift Thickness. The minimum compacted lift thickness for HMA binder and surface courses shall be as follows.

| MINIMUM COMPACTED LIFT THICKNESS | |
|---|---|
| Mixture Composition | Thickness, in. (mm) |
| IL-4.75 | 3/4 (19) - over HMA surfaces [1/]<br>1 (25) - over PCC surfaces [1/] |
| IL-9.5FG | 1 1/4 (32) |
| IL-9.5, IL-9.5L | 1 1/2 (38) |
| SMA 9.5 | 1 3/4 (45) |
| SMA 12.5 | 2 (51) |
| IL-19.0, IL-19.0L | 2 1/4 (57) |

1/ The maximum compacted lift thickness for mixture IL-4.75 shall be 1 1/4 in. (32 mm)."

Revise Table 1 and Note 3/ of Table 1 in Article 406.07(a) of the Standard Specifications to read:

| "TABLE 1 - MINIMUM ROLLER REQUIREMENTS FOR HMA | | | | |
|---|---|---|---|---|
| | Breakdown Roller (one of the following) | Intermediate Roller | Final Roller (one or more of the following) | Density Requirement |
| Binder and Surface [1/] | $V_D$, P [3/], $T_B$, 3W, $O_T$, $O_B$ | P [3/], $O_T$, $O_B$ | $V_S$, $T_B$, $T_F$, $O_T$ | As specified in Articles: 1030.05(d)(3), (d)(4), and (d)(7). |
| IL-4.75 and SMA [4/ 5/] | $T_B$, 3W, $O_T$ | - - | $T_F$, 3W, $O_T$ | |
| Bridge Decks [2/] | $T_B$ | - - | $T_F$ | As specified in Articles 582.05 and 582.06. |

3/ A vibratory roller ($V_D$) or oscillatory roller ($O_T$ or $O_B$) may be used in lieu of the pneumatic-tired roller on mixtures containing polymer modified asphalt binder."

Add the following to EQUIPMENT DEFINITION in Article 406.07(a) contained in the Errata of the Supplemental Specifications:

"$O_T$ - Oscillatory roller, tangential impact mode. Maximum speed is 3.0 mph (4.8 km/h) or 264 ft/min (80 m/min).

$O_B$ - Oscillatory roller, tangential and vertical impact mode, operated at a speed to produce not less than 10 vertical impacts/ft (30 impacts/m)."

Delete last sentence of the second paragraph of Article 1102.01(a) (4) b. 2.

Add to the end of Article 1102.01 (a) (4) b. 2.:

"As an option, collected dust (baghouse) may be used in lieu of manufactured mineral filler according to the following:

(a.) Sufficient collected dust (baghouse) is available for production of the SMA mix for the entire project.

(b.) A mix design was prepared based on collected dust (baghouse).

Revise Article 1030.04 (d) of the Standard Specifications to read:

"(d) Verification Testing. High ESAL, IL-4.75, and SMA mix designs submitted for verification will be tested to ensure that the resulting mix designs will pass the required criteria for the Hamburg Wheel Test (IL mod AASHTO T-324) and the Tensile Strength Test (IL mod AASHTO T-283). The Department will perform a verification test on gyratory specimens compacted by the Contractor. If the mix fails the Department's verification test, the Contractor shall make the necessary changes to the mix and resubmit compacted specimens to the Department for verification. If the mix fails again, the mix design will be rejected.

All new mix designs will be required to be tested, prior to submittal for Department verification and shall meet the following requirements:

(1) Hamburg Wheel Test criteria. The maximum allowable rut depth shall be 0.5 in. (12.5 mm). The minimum number of wheel passes at the 0.5 in. (12.5 mm) rut depth criteria shall be based on the high temperature binder grade of the mix as specified in the mix requirements table of the plans.

Illinois Modified AASHTO T 324 Requirements [1/]

| Asphalt Binder Grade | # Repetitions | Max Rut Depth (mm) |
|---|---|---|
| PG 70 -XX (or higher) | 20,000 | 12.5 |
| PG 64 -XX (or lower) | 10,000 | 12.5 |

1/ When produced at temperatures of 275 ± 5 °F (135 ± 3 °C) or less, loose Warm Mix Asphalt shall be oven aged at 270 ± 5 °F (132 ± 3 °C) for two hours prior to gyratory compaction of Hamburg Wheel specimens.

Note: For SMA Designs (N-80) the maximum rut depth is 6.0 mm at 20,000 repetitions.
For IL 4.75mm Designs (N-50) the maximum rut depth is 9.0mm at 15,000 repetitions.

(2) Tensile Strength Criteria. The minimum allowable conditioned tensile strength shall be 60 psi (415 kPa) for non-polymer modified performance graded (PG) asphalt binder and 80 psi (550 kPa) for polymer modified PG asphalt binder. The maximum allowable unconditioned tensile strength shall be 200 psi (1380 kPa)."

Production Testing. Revise first paragraph of Article 1030.06(a) of the Standard Specifications to read:

"(a) High ESAL, IL-4.75, WMA, and SMA Mixtures. For each contract, a 300 ton (275 metric tons) test strip, except for SMA mixtures it will be 400 ton (363 metric ton), will be required at the beginning of HMA production for each mixture at the beginning of each construction year according to the Manual of Test Procedures for Materials "Hot Mix Asphalt Test Strip Procedures". At the request of the Producer, the Engineer may waive the test strip if previous construction during the current construction year has demonstrated the constructability of the mix using Department test results."

Add the following after the sixth paragraph in Article 1030.06 (a) of the Standard Specifications:

"The Hamburg Wheel test shall also be conducted on all HMA mixtures from a sample taken within the first 500 tons (450 metric tons) on the first day of production or during start up with a split reserved for the Department. The mix sample shall be tested according to the Illinois Modified AASHTO T 324 and shall meet the requirements specified herein. Mix production shall not exceed 1500 tons (1350 metric tons) or one day's production, whichever comes first, until the testing is completed and the mixture is found to be in conformance. The requirement to cease mix production may be waived if the plant produced mixture demonstrates conformance prior to start of mix production for a contract.
If the mixture fails to meet the Hamburg Wheel criteria, no further mixture will be accepted until the Contractor takes such action as is necessary to furnish a mixture meeting the criteria"

Method of Measurement:

Add the following after the fourth paragraph of Article 406.13 (b):

"The plan quantities of SMA mixtures shall be adjusted using the actual approved binder and surface Mix Design's $G_{mb}$."

Basis of Payment. Replace the second through the fifth paragraphs of Article 406.14 with the following:

"HMA binder and surface courses will be paid for at the contract unit price per ton (metric ton) for MIXTURE FOR CRACKS, JOINTS, AND FLANGEWAYS; HOT-MIX ASPHALT BINDER COURSE (HAND METHOD), of the Ndesign specified; HOT-MIX ASPHALT BINDER COURSE, of the mixture composition and Ndesign specified; HOT-MIX ASPHALT SURFACE COURSE, of the mixture composition, friction aggregate, and Ndesign specified; POLYMERIZED HOT-MIX ASPHALT BINDER COURSE (HAND METHOD), of the Ndesign specified; POLYMERIZED HOT-MIX ASPHALT BINDER COURSE, of the mixture composition and Ndesign specified; POLYMERIZED HOT-MIX ASPHALT SURFACE COURSE, of the mixture composition, friction aggregate, and Ndesign specified; POLYMERIZED HOT-MIX ASPHALT BINDER COURSE, STONE MATRIX ASPHALT, of the mixture composition and Ndesign specified; POLYMERIZED HOT-MIX ASPHALT SURFACE COURSE, STONE MATRIX ASPHALT, of the mixture composition, friction aggregate, and Ndesign specified."

**LIGHTWEIGHT CELLULAR CONCRETE FILL (D-1)**
Effective: November 11, 2001 Revised: June 18, 2018

**General:** This work consists of providing lightweight cellular concrete fill (LCCF) at the locations(s) and according to the dimensions shown in the contract plans, and as directed by the Engineer.

**Submittals:** Within 45 calendar days prior to proposed installation, the Contractor shall submit the following:

(a) The name of the subcontractor providing and installing the light weight cellular fill. The Contractor shall present an organization chart including names, telephone numbers, current certifications and/ or titles, and roles and responsibilities of all those involved in the manufacturing and installation of the lightweight cellular fill.

(b) Manufacturer's specifications, catalog cuts, and other product data needed to demonstrate compliance with specified requirements. These shall include reports and test results from laboratories.

(c) The subcontractor installing the lightweight fill shall be certified in writing by the Manufacturer of the lightweight fill. The certified applicator shall be regularly engaged in the placement of lightweight fill of a similar nature including the completion of mass fills having a minimum of 13,000 cu yd (9,950 cu m) in the past five years.

(d) A description of the proposed installation procedure. The procedure shall address the following.

(1) Proposed construction sequence and schedule.

(2) Location of the equipment and batching areas.

(3) Type of equipment and tools to be used.

**Materials.** Materials shall be according to the following.

| Item | Article/Section |
|---|---|
| (a) Portland Cement (Note 1) | 1001 |
| (b) Water | 1002 |
| (c) Fine Aggregate | 1003 |
| (d) Concrete Admixtures | 1021 |
| (e) Foaming Agent (Note 2) | |

Note 1. Pozzolans and finely divided minerals will not be permitted.

Note 2. The foaming agent shall be according to ASTM C 869, and shall be listed on the Department's Approved/Qualified Product List of Foaming Agents for Cellular Concrete. The manufacturer shall provide an infrared spectrophotometer trace no more than five years old. When the infrared spectrophotometer trace is more than seven years old, a new one shall be provided.

**Equipment.** Equipment shall be according to the following.

| Item | Article/Section |
|---|---|
| (a) Concrete Mixers and Trucks | 1103.01 |
| (b) Batching and Weighing Equipment | 1103.02 |
| (c) Automatic and Semi-Automatic Batching Equipment | 1103.03 |
| (d) Water Supply Equipment | 1103.11 |
| (e) Mobile Portland Cement Concrete Plants | 1103.04 |
| (f) Foam Generator (Notes 1 & 3) | |
| (g) Mobile Site Batch Plant (Notes 2 & 3) | |

Note 1. Foam generating equipment shall be calibrated daily to produce an accurate volume of foam.

Note 2. Mobile site batch plants shall be capable of mixing and pumping cellular concrete, and shall have a minimum 1 cu yd (0.76 cu m) capacity. Mobile site plants shall be calibrated before the start of the project, and then during the project as determined by the Engineer.

Note 3. Foam generators and mobile site batch plants shall be certified in writing by the manufacturer of the lightweight cellular concrete and approved by the Engineer.

**Lightweight Cellular Concrete Classes.** The four general classes of lightweight cellular concrete delineated by as-cast density and minimum compressive strength are given in Table 1. If the class of lightweight cellular concrete is not specified in the contract, the class to use shall be as directed by the Engineer.

Table 1. CLASSES OF LIGHTWEIGHT CELLULAR CONCRETE

| Class | Maximum Lift Height ft (m) | As-Cast Density lb/cu ft (kg/cu m) | Minimum Compressive Strength Psi (kPa) | |
|---|---|---|---|---|
| | | | Days | |
| | | | 7 | 28 |
| I | 4 (1.2) | 24 - 32 (384 - 513) | 30 (205) | 40 (275) |
| II | 4 (1.2) | 30 - 38 (481 - 609) | 60 (415) | 80 (550) |
| III | 2.5 (0.76) | 36 - 44 (577 - 705) | 90 (620) | 120 (825) |
| IV | 2.5 (0.76) | 44 - 52 (705 - 833) | 115 (795) | 150 (1035) |

**Other Lightweight Cellular Concrete Criteria.** The lightweight cellular concrete shall be according to the following.

(a) Proportioning and Mix Design. For all Classes of lightweight cellular concrete, it shall be the Contractor's responsibility to determine the mix design material proportions and to proportion each batch. The Contractor shall provide the mix designs a minimum of 45 calendar days prior to production. The Engineer will verify the mix design submitted by the Contractor.

For a new mix design to be verified, the Engineer will require the Contractor to provide a trial batch at no cost to the Department. The trial batch shall be scheduled a minimum of 30 calendar days prior to anticipated use and shall be performed in the presence of the Engineer. A minimum of 1 cu yd (0.75 cu m) trial batch shall be produced and placed offsite. The trial batch shall be produced with the equipment, materials, and methods intended for construction. The trial batch will be evaluated and tested by the Contractor and Engineer via split samples for as-cast density and compressive strength according to the sampling and testing requirements specified herein. The lightweight cellular concrete will also be evaluated and tested by the Engineer according to Illinois Test Procedure 501, as applicable.

Verification of the mix design will include trial batch test results and other criteria as determined by the Engineer. The Contractor will be notified in writing of verification. Verification of a mix design shall in no manner be construed as acceptance of any mixture produced. Tests performed at the jobsite will determine if a mix design can meet specifications.

(b) Admixtures. Admixture use shall be according to Article 1020.05(b).

(c) Temperature. The air temperature at the time of placement and for 24 hours thereafter shall be a minimum of 35 °F (2 °C). The temperature of the lightweight cellular concrete at point of discharge shall be a minimum of 45 °F (7 °C) and a maximum of 95 °F (35 °C).

**Curing.** Curing may be required for applications with significant surface area exposed (least width dimension of minimum 80 ft (24 m)) to the elements if rapid drying conditions are expected during placement, as determined by the Engineer. When curing is required, each lift shall be cured with a method recommended by the manufacturer of the lightweight cellular concrete. If curing compound is used, it shall be compatible with other construction materials it may interact with, and shall not inhibit bond of subsequent lifts.

**Quality Control Sampling and Testing by the Contractor.** The Contractor shall sample and test the lightweight cellular concrete as follows:

(a) As-Cast Density. The first batch placed each day and a minimum rate of one per hour thereafter shall be sampled and tested as described for “experimental density of the concrete after pumping” according to ASTM C 796, except the hose length shall be that used for jobsite placement. The as-cast density shall be the average of at least two tests. Additional tests shall be done if adjustments are made to the materials. These tests shall be documented.

If the average as-cast density is outside the specified tolerance from Table 1, the Contractor shall reject the batch or make an adjustment to the mix before placement. Adjustments to the mix shall be accomplished by either increasing or decreasing the foam only.

(b) Compressive Strength. First batch placed each day and every 200 cu yd (155 cu m) thereafter shall be sampled according to ASTM C 495, except that samples shall not be oven dried at any time before testing. The minimum number of batches sampled per day shall be two. Eight 3 in. x 6 in. (75 mm x 150 mm) cylindrical test specimens shall be molded from each sample.

A compressive strength test is defined as the average of four cylinder breaks. For each sample, tests shall be conducted at 7 and 28 days.

**Quality Assurance Sampling and Testing by the Engineer.** The Engineer will sample and test the lightweight cellular concrete for quality assurance on independent and split samples. An independent sample is a field sample obtained and tested by only one party. A split sample is one of two equal portions of a field sample, where two parties each receive one portion for testing. The Engineer may request the Contractor to obtain a split sample. Any failing strength test specimen shall be retained until permission is given by the Engineer for disposal. The results of all quality assurance tests by the Engineer will be made available to the Contractor. However, Contractor split sample test results shall be provided to the Engineer before Department test results are revealed. The Engineer's quality assurance independent sample and split sample testing for placement or acceptance will be as follows:

(a) As-Cast Density. One independent or split sample test for the first batch placed each day and as determined by the Engineer thereafter.

(b) Compressive Strength. One independent or split sample for the first batch placed each day and as determined by the Engineer thereafter.

**Comparing Test Results.** Differences between the Engineer's and the Contractor's split sample test results will be considered reasonable if within the following limits.

| Test Parameter | Acceptable Limits of Precision |
|---|---|
| Compressive Strength | 5 psi (34.5 kPa) |
| Density | 1 lb/cu ft (16 kg/cu m) |

Action shall be taken when either the Engineer's or the Contractor's test results are not within specification limits for strength or density. Action may include, but is not limited to, the Contractor being required to replace or repair test equipment as determined by the Engineer.

Placed material that fails in compressive strength will be considered unacceptable.

**Acceptance by the Engineer.** Final acceptance will be based on the Standard Specifications and the following:

(a) Validation of Contractor quality control test results using split samples. Any quality control or quality assurance test determined to be flawed may be declared invalid only when reviewed and approved by the Engineer. The Engineer will declare a test result invalid only if it is proven that improper sampling or testing occurred. The test result is to be recorded and the reason for declaring the test invalid will be provided by the Engineer.

(b) Comparison of the Engineer's quality assurance test results with specification limits using samples independently obtained by the Engineer.

The Engineer may suspend mixture production, reject materials, or take other appropriate action if the Contractor does not control the quality of lightweight cellular concrete. The decision will be determined according to (a) or (b).

**Installation.** Prior to installation, the ground surface shall be cleared of organic top soils, debris, sharp objects, and trees. Tree stumps shall be either removed or cut to the level of the ground surface. All wheel tracks or ruts in excess of 3 in. (75 mm) in depth shall be graded smooth or otherwise filled with soil to provide a reasonable smooth surface.

If a geotechnical fabric for ground stabilization or geomembrane is specified in conjunction with the LCCF, it shall be furnished and installed as specified elsewhere in the Contract and shall be in place prior to placing the LCCF.

The lightweight cellular concrete fill shall be placed according to the approved installation procedures provided by the manufacturer.

There shall be no standing water in the area to be filled. If necessary, dewatering shall be continuous during the time the lightweight cellular concrete fill is constructed. Lightweight cellular concrete fill shall not be placed during or when periods of precipitation are expected unless placed in an enclosed, covered area and the ground water is diverted away from the LCCF.

If any items are to be encased in the fill, the items shall be set to the final location both horizontally and vertically prior to installation of the LCCF.

Mixing and placement of the LCCF shall be done as follows:

(a) After mixing, the materials shall be promptly placed in the final location.

(b) No mechanical vibration of the LCCF shall be permitted.

(c) The material shall be placed to prevent segregation. Intermediate lifts shall be placed horizontal while only the top lift shall be sloped to grade. The final surface elevation of the lightweight cellular concrete fill shall be within ±1.5 inches (±38 mm) of the plan elevation.

(d) Limit the area of placement to the volume that can be placed within 1 hour, up to the maximum lift height. Stagger placements such that the vertical joints are at least 10 ft (3 m) apart.

(e) The cellular concrete shall be placed with a hose. The discharge hose length shall not exceed 800 ft (244 m) in length. Discharge from the hose shall not be allowed to flow more than 30 ft (9 m) from where it is deposited to its final position.

(f) Heavy construction equipment or other unusual loading of the lightweight cellular concrete fill shall not be permitted.

(g) Construction activities on any recently placed lift will not be permitted until at least 12 hours has elapsed and a minimum compressive strength of 8 psi (50 kPa) has been achieved. However, if any work on the recently placed LCCF results in cracking or indentations of more than an 0.125 inch (3 mm), the contractor shall discontinue construction, revise their wait time, mix strength or equipment used and submit to the Engineer for approval.

(h) Sawing or ripping of the lightweight cellular concrete fill for utilities, drains or other conflicts will be by methods approved by the Engineer and lightweight cellular concrete fill Manufacturer.

Method of Measurement. Lightweight cellular fill shall be measured for payment in cubic yards (cubic meters) according to Article 202.07.

Basis of Payment. This work will be paid for at the contract unit price per cubic yards (cubic meter) for LIGHTWEIGHT CELLULAR CONCRETE FILL.

**RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (D-1)**
Effective: November 1, 2012 Revise: January 1, 2018

Revise Section 1031 of the Standard Specifications to read:

"**SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES**

**1031.01 Description.** Reclaimed asphalt pavement and reclaimed asphalt shingles shall be according to the following.

(a) Reclaimed Asphalt Pavement (RAP). RAP is the material resulting from cold milling or crushing an existing hot-mix asphalt (HMA) pavement. RAP will be considered processed FRAP after completion of both crushing and screening to size. The Contractor shall supply written documentation that the RAP originated from routes or airfields under federal, state, or local agency jurisdiction.

(b) Reclaimed Asphalt Shingles (RAS). Reclaimed asphalt shingles (RAS). RAS is from the processing and grinding of preconsumer or post-consumer shingles. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable material, as defined in Central Bureau of Materials Policy Memorandum, "Reclaimed Asphalt Shingle (RAS) Sources", by weight of RAS. All RAS used shall come from a Central Bureau of Materials approved processing facility where it shall be ground and processed to 100 percent passing the 3/8 in. (9.5 mm) sieve and 90 percent passing the #4 (4.75 mm) sieve. RAS shall meet the testing requirements specified herein. In addition, RAS shall meet the following Type 1 or Type 2 requirements.

(1) Type 1. Type 1 RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.

(2) Type 2. Type 2 RAS shall be processed post-consumer shingles only, salvaged from residential, or four unit or less dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP).

**1031.02 Stockpiles.** RAP and RAS stockpiles shall be according to the following.

(a) RAP Stockpiles. The Contractor shall construct individual, sealed RAP stockpiles meeting one of the following definitions. Additional processed RAP (FRAP) shall be stockpiled in a separate working pile, as designated in the QC Plan, and only added to the sealed stockpile when test results for the working pile are complete and are found to meet tolerances specified herein for the original sealed FRAP stockpile. Stockpiles shall be sufficiently separated to prevent intermingling at the base. All stockpiles (including unprocessed RAP and FRAP) shall be identified by signs indicating the type as listed below (i.e. “Non- Quality, FRAP -#4 or Type 2 RAS”, etc…).

(1) Fractionated RAP (FRAP). FRAP shall consist of RAP from Class I, HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in FRAP shall be crushed aggregate and may represent more than one aggregate type and/or quality, but shall be at least C quality. All FRAP shall be processed prior to testing and sized into fractions with the separation occurring on or between the #4 (4.75 mm) and 1/2 in. (12.5 mm) sieves. Agglomerations shall be minimized such that 100 percent of the RAP in the coarse fraction shall pass the maximum sieve size specified for the mix the FRAP will be used in.

(2) Restricted FRAP (B quality) stockpiles shall consist of RAP from Class I, HMA (High ESAL), or HMA (High ESAL). If approved by the Engineer, the aggregate from a maximum 3.0 in. (75 mm) single combined pass of surface/binder milling will be classified as B quality. All millings from this application will be processed into FRAP as described previously.

(3) Conglomerate. Conglomerate RAP stockpiles shall consist of RAP from Class I, HMA (High and Low ESAL) or equivalent mixtures. The coarse aggregate in this RAP shall be crushed aggregate and may represent more than one aggregate type and/or quality, but shall be at least C quality. This RAP may have an inconsistent gradation and/or asphalt binder content prior to processing. All conglomerate RAP shall be processed (FRAP) prior to testing. Conglomerate RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(4) Conglomerate “D” Quality (DQ). Conglomerate DQ RAP stockpiles shall consist of RAP from HMA shoulders, bituminous stabilized subbases or HMA (Low ESAL)/HMA (Low ESAL) IL-19.0L binder mixture. The coarse aggregate in this RAP may be crushed or round but shall be at least D quality. This RAP may have an inconsistent gradation and/or asphalt binder content. Conglomerate DQ RAP stockpiles shall not contain steel slag or other expansive material as determined by the Department.

(5) Non-Quality. RAP stockpiles that do not meet the requirements of the stockpile categories listed above shall be classified as “Non-Quality”.

RAP or FRAP containing contaminants, such as earth, brick, sand, concrete, sheet asphalt, bituminous surface treatment (i.e. chip seal), pavement fabric, joint sealants, plant cleanout etc., will be unacceptable unless the contaminants are removed to the satisfaction of the Engineer. Sheet asphalt shall be stockpiled separately.

(b) RAS Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall be sufficiently separated to prevent intermingling at the base. Each stockpile shall be signed indicating what type of RAS is present.

However, a RAS source may submit a written request to the Department for approval to blend mechanically a specified ratio of Type 1 RAS with Type 2 RAS. The source will not be permitted to change the ratio of the blend without the Department prior written approval. The Engineer's written approval will be required, to mechanically blend RAS with any fine aggregate produced under the AGCS, up to an equal weight of RAS, to improve workability. The fine aggregate shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The fine aggregate shall be one that is approved for use in the HMA mixture and accounted for in the mix design and during HMA production.

Records identifying the shingle processing facility supplying the RAS, RAS type, and lot number shall be maintained by project contract number and kept for a minimum of three years.

**1031.03 Testing.** FRAP and RAS testing shall be according to the following.

(a) FRAP Testing. When used in HMA, the FRAP shall be sampled and tested either during processing or after stockpiling. It shall also be sampled during HMA production.

(1) During Stockpiling. For testing during stockpiling, washed extraction samples shall be run at the minimum frequency of one sample per 500 tons (450 metric tons) for the first 2000 tons (1800 metric tons) and one sample per 2000 tons (1800 metric tons) thereafter. A minimum of five tests shall be required for stockpiles less than 4000 tons (3600 metric tons).

(2) Incoming Material. For testing as incoming material, washed extraction samples shall be run at a minimum frequency of one sample per 2000 tons (1800 metric tons) or once per week, whichever comes first.

(3) After Stockpiling. For testing after stockpiling, the Contractor shall submit a plan for approval to the District proposing a satisfactory method of sampling and testing the RAP/FRAP pile either in-situ or by restockpiling. The sampling plan shall meet the minimum frequency required above and detail the procedure used to obtain representative samples throughout the pile for testing.

Before extraction, each field sample of FRAP, shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedure. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

(b) RAS Testing. RAS shall be sampled and tested during stockpiling according to Central Bureau of Materials Policy Memorandum, "Reclaimed Asphalt Shingle (RAS) Sources". The Contractor shall also sample as incoming material at the HMA plant.

(1) During Stockpiling. Washed extraction and testing for unacceptable materials shall be run at the minimum frequency of one sample per 200 tons (180 metric tons) for the first 1000 tons (900 metric tons) and one sample per 1000 tons (900 metric tons) thereafter. A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). Once a ≤ 1000 ton (900 metric ton), five-sample/test stockpile has been established it shall be sealed. Additional incoming RAS shall be in a separate working pile as designated in the Quality Control plan and only added to the sealed stockpile when the test results of the working pile are complete and are found to meet the tolerances specified herein for the original sealed RAS stockpile.

(2) Incoming Material. For testing as incoming material at the HMA plant, washed extraction shall be run at the minimum frequency of one sample per 250 tons (227 metric tons). A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). The incoming material test results shall meet the tolerances specified herein.

The Contractor shall obtain and make available all test results from start of the initial stockpile sampled and tested at the shingle processing facility in accordance with the facility's QC Plan.

Before extraction, each field sample shall be split to obtain two samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedures. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

**1031.04 Evaluation of Tests.** Evaluation of test results shall be according to the following.

(a) Evaluation of FRAP Test Results. All test results shall be compiled to include asphalt binder content, gradation and, when applicable (for slag), $G_{mm}$. A five test average of results from the original pile will be used in the mix designs. Individual extraction test results run thereafter, shall be compared to the average used for the mix design, and will be accepted if within the tolerances listed below.

| Parameter | FRAP |
|---|---|
| No. 4 (4.75 mm) | ± 6 % |
| No. 8 (2.36 mm) | ± 5 % |
| No. 30 (600 µm) | ± 5 % |
| No. 200 (75 µm) | ± 2.0 % |
| Asphalt Binder | ± 0.3 % |
| $G_{mm}$ | ± 0.03 1/ |

1/ For stockpile with slag or steel slag present as determined in the current Manual of Test Procedures Appendix B 21, "Determination of Reclaimed Asphalt Pavement Aggregate Bulk Specific Gravity".

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the FRAP stockpile shall not be used in Hot-Mix Asphalt unless the FRAP representing those tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

The Contractor shall maintain a representative moving average of five tests to be used for Hot-Mix Asphalt production.

With the approval of the Engineer, the ignition oven may be substituted for extractions according to the ITP, "Calibration of the Ignition Oven for the Purpose of Characterizing Reclaimed Asphalt Pavement (RAP)" or Illinois Modified AASHTO T-164-11, Test Method A.

(b) Evaluation of RAS Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content and gradation. A five test average of results from the original pile will be used in the mix designs. Individual test results run thereafter, when compared to the average used for the mix design, will be accepted if within the tolerances listed below.

| Parameter | RAS |
|---|---|
| No. 8 (2.36 mm) | ± 5 % |
| No. 16 (1.18 mm) | ± 5 % |
| No. 30 (600 µm) | ± 4 % |
| No. 200 (75 µm) | ± 2.5 % |
| Asphalt Binder Content | ± 2.0 % |

If any individual sieve and/or asphalt binder content tests are out of the above tolerances when compared to the average used for the mix design, the RAS shall not be used in Hot-Mix Asphalt unless the RAS representing those tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

(c) Quality Assurance by the Engineer. The Engineer may witness the sampling and splitting conduct assurance tests on split samples taken by the Contractor for quality control testing a minimum of once a month.

The overall testing frequency will be performed over the entire range of Contractor samples for asphalt binder content and gradation. The Engineer may select any or all split samples for assurance testing. The test results will be made available to the Contractor as soon as they become available.

The Engineer will notify the Contractor of observed deficiencies.

Differences between the Contractor's and the Engineer's split sample test results will be considered acceptable if within the following limits.

| Test Parameter | Acceptable Limits of Precision | |
|---|---|---|
| % Passing:[1/] | FRAP | RAS |
| 1/2 in. | 5.0% | |
| No. 4 | 5.0% | |
| No. 8 | 3.0% | 4.0% |
| No. 30 | 2.0% | 4.0% |
| No. 200 | 2.2% | 4.0% |
| Asphalt Binder Content | 0.3% | 3.0% |
| $G_{mm}$ | 0.030 | |

1/ Based on washed extraction.

In the event comparisons are outside the above acceptable limits of precision, the Engineer will immediately investigate.

(d) Acceptance by the Engineer. Acceptable of the material will be based on the validation of the Contractor's quality control by the assurance process.

**1031.05 Quality Designation of Aggregate in RAP and FRAP.**

(a) RAP. The aggregate quality of the RAP for homogeneous, conglomerate, and conglomerate "D" quality stockpiles shall be set by the lowest quality of coarse aggregate in the RAP stockpile and are designated as follows.

(1) RAP from Class I, HMA (High ESAL), or (Low ESAL) IL-9.5L surface mixtures are designated as containing Class B quality coarse aggregate.

(2) RAP from HMA (Low ESAL) IL-19.0L binder mixture is designated as Class D quality coarse aggregate.

(3) RAP from Class I, HMA (High ESAL) binder mixtures, bituminous base course mixtures, and bituminous base course widening mixtures are designated as containing Class C quality coarse aggregate.

(4) RAP from bituminous stabilized subbase and BAM shoulders are designated as containing Class D quality coarse aggregate.

(b) FRAP. If the Engineer has documentation of the quality of the FRAP aggregate, the Contractor shall use the assigned quality provided by the Engineer.

If the quality is not known, the quality shall be determined as follows. Fractionated RAP stockpiles containing plus #4 (4.75 mm) sieve coarse aggregate shall have a maximum tonnage of 5,000 tons (4,500 metric tons). The Contractor shall obtain a representative sample witnessed by the Engineer. The sample shall be a minimum of 50 lb (25 kg). The sample shall be extracted according to Illinois Modified AASHTO T 164 by a consultant laboratory prequalified by the Department for the specified testing. The consultant laboratory shall submit the test results along with the recovered aggregate to the District Office. The cost for this testing shall be paid by the Contractor. The District will forward the sample to the Central Bureau of Materials Aggregate Lab for MicroDeval Testing, according to ITP 327. A maximum loss of 15.0 percent will be applied for all HMA applications. The fine aggregate portion of the fractionated RAP shall not be used in any HMA mixtures that require a minimum of "B" quality aggregate or better, until the coarse aggregate fraction has been determined to be acceptable thru a MicroDeval Testing.

**1031.06 Use of FRAP and/or RAS in HMA.** The use of FRAP and/or RAS shall be the Contractor's option when constructing HMA in all contracts.

(a) FRAP. The use of FRAP in HMA shall be as follows.

(1) Coarse Aggregate Size (after extraction). The coarse aggregate in all FRAP shall be equal to or less than the nominal maximum size requirement for the HMA mixture to be produced.

(2) Steel Slag Stockpiles. FRAP stockpiles containing steel slag or other expansive material, as determined by the Department, shall be homogeneous and will be approved for use in HMA (High ESAL and Low ESAL) mixtures regardless of lift or mix type.

(3) Use in HMA Surface Mixtures (High and Low ESAL). FRAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall have coarse aggregate that is Class B quality or better. FRAP shall be considered equivalent to limestone for frictional considerations unless produced/screened to minus 3/8 inch.

(4) Use in HMA Binder Mixtures (High and Low ESAL), HMA Base Course, and HMA Base Course Widening. FRAP stockpiles for use in HMA binder mixtures (High and Low ESAL), HMA base course, and HMA base course widening shall be FRAP in which the coarse aggregate is Class C quality or better.

(5) Use in Shoulders and Subbase. FRAP stockpiles for use in HMA shoulders and stabilized subbase (HMA) shall be FRAP, Restricted FRAP, conglomerate, or conglomerate DQ.

(b) RAS. RAS meeting Type 1 or Type 2 requirements will be permitted in all HMA applications as specified herein.

(c) FRAP and/or RAS Usage Limits. Type 1 or Type 2 RAS may be used alone or in conjunction with FRAP in HMA mixtures up to a maximum of 5.0 percent by weight of the total mix.

When FRAP is used alone or FRAP is used in conjunction with RAS, the percent of virgin asphalt binder replacement (ABR) shall not exceed the amounts indicated in the table below for a given N Design.

Max Asphalt Binder Replacement for FRAP with RAS Combination

| HMA Mixtures [1/ 2/ 4/] | Maximum % ABR | | |
|---|---|---|---|
| Ndesign | Binder/Leveling Binder | Surface | Polymer Modified [3/] |
| 30L | 50 | 40 | 30 |
| 50 | 40 | 35 | 30 |
| 70 | 40 | 30 | 30 |
| 90 | 40 | 30 | 30 |
| 4.75 mm N-50 | | | 40 |
| SMA N-80 | | | 30 |

1/ For Low ESAL HMA shoulder and stabilized subbase, the percent asphalt binder replacement shall not exceed 50 % of the total asphalt binder in the mixture.

2/ When the binder replacement exceeds 15 % for all mixes, except for SMA and IL-4.75, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 % binder replacement using a virgin asphalt binder grade of PG64-22 will be reduced to a PG58-28). When constructing full depth HMA and the ABR is less than 15 %, the required virgin asphalt binder grade shall be PG64-28.

3/ When the ABR for SMA or IL-4.75 is 15 % or less, the required virgin asphalt binder shall be SBS PG76-22 and the elastic recovery shall be a minimum of 80. When the ABR for SMA or IL-4.75 exceeds 15%, the virgin asphalt binder grade shall be SBS PG70-28 and the elastic recovery shall be a minimum of 80.

4/ When FRAP or RAS is used alone, the maximum percent asphalt binder replacement designated on the table shall be reduced by 10 %.

**1031.07 HMA Mix Designs.** At the Contractor's option, HMA mixtures may be constructed utilizing RAP/FRAP and/or RAS material meeting the detailed requirements specified herein.

(a) FRAP and/or RAS. FRAP and /or RAS mix designs shall be submitted for verification. If additional FRAP or RAS stockpiles are tested and found to be within tolerance, as defined under "Evaluation of Tests" herein, and meet all requirements herein, the additional FRAP or RAS stockpiles may be used in the original design at the percent previously verified.

(b) RAS. Type 1 and Type 2 RAS are not interchangeable in a mix design.

The RAP, FRAP and RAS stone specific gravities ($G_{sb}$) shall be according to the "Determination of Aggregate Bulk (Dry) Specific Gravity ($G_{sb}$) or Reclaimed Asphalt Pavement (RAP) and Reclaimed Asphalt Shingles (RAS)" procedure in the Department's Manual of Test Procedures for Materials.

**1031.08 HMA Production.** HMA production utilizing FRAP and/or RAS shall be as follows.

To remove or reduce agglomerated material, a scalping screen, gator, crushing unit, or comparable sizing device approved by the Engineer shall be used in the RAS and FRAP feed system to remove or reduce oversized material. .

If during mix production, corrective actions fail to maintain FRAP, RAS or QC/QA test results within control tolerances or the requirements listed herein the Contractor shall cease production of the mixture containing FRAP or RAS and conduct an investigation that may require a new mix design.

(a) RAS. RAS shall be incorporated into the HMA mixture either by a separate weight depletion system or by using the RAP weigh belt. Either feed system shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes. The portion of RAS shall be controlled accurately to within ± 0.5 percent of the amount of RAS utilized. When using the weight depletion system, flow indicators or sensing devices shall be provided and interlocked with the plant controls such that the mixture production is halted when RAS flow is interrupted.

(b) HMA Plant Requirements. HMA plants utilizing FRAP and/or RAS shall be capable of automatically recording and printing the following information.

(1) Dryer Drum Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

d. Accumulated dry weight of RAS and FRAP in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

e. Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.

f. Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.

g. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

h. Aggregate RAS and FRAP moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAS and FRAP are printed in wet condition.)

i. When producing mixtures with FRAP and/or RAS, a positive dust control system shall be utilized.

j. Accumulated mixture tonnage.

k. Dust Removed (accumulated to the nearest 0.1 ton (0.1 metric ton))

(2) Batch Plants.
a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).

d. Mineral filler weight to the nearest pound (kilogram).

f. RAS and FRAP weight to the nearest pound (kilogram).

g. Virgin asphalt binder weight to the nearest pound (kilogram).

h. Residual asphalt binder in the RAS and FRAP material as a percent of the total mix to the nearest 0.1 percent.

The printouts shall be maintained in a file at the plant for a minimum of one year or as directed by the Engineer and shall be made available upon request. The printing system will be inspected by the Engineer prior to production and verified at the beginning of each construction season thereafter.

**1031.09 RAP in Aggregate Surface Course and Aggregate Wedge Shoulders, Type B.** The use of RAP or FRAP in aggregate surface course and aggregate shoulders shall be as follows.

(a) Stockpiles and Testing. RAP stockpiles may be any of those listed in Article 1031.02, except “Non-Quality” and “FRAP”. The testing requirements of Article 1031.03 shall not apply. RAP used shall be according to the current Central Bureau of Materials Policy Memorandum, “Reclaimed Asphalt Pavement (RAP) for Aggregate Applications”.

(b) Gradation. The RAP material shall meet the gradation requirements for CA 6 according to Article 1004.01(c), except the requirements for the minus No. 200 (75 µm) sieve shall not apply. The sample for the RAP material shall be air dried to constant weight prior to being tested for gradation.”

**TEMPORARY PAVEMENT**
Effective: March 1, 2003 Revised: April 10, 2008

Description. This work shall consist of constructing a temporary pavement at the locations shown on the plans or as directed by the engineer.

The contractor shall use either Portland cement concrete according to Sections 353 and 354 of the Standard Specifications or HMA according to Sections 355, 356, 406 of the Standard Specifications, and other applicable HMA special provisions as contained herein. The HMA mixtures to be used shall be specified in the plans. The thickness of the Temporary Pavement shall be as described in the plans. The contractor shall have the option of constructing either material type if both Portland cement concrete and HMA are shown in the plans.

Articles 355.08 and 406.11 of the Standard Specifications shall not apply.

The removal of the Temporary Pavement, if required, shall conform to Section 440 of the Standard Specification.

Method of Measurement. Temporary pavement will be measured in place and the area computed in square yards (square meters).

Basis of Payment. This work will be paid for at the contract unit price per square yard (square meter) for TEMPORARY PAVEMENT and TEMPORARY PAVEMENT (INTERSTATE).

Removal of temporary pavement will be paid for at the contract unit price per square yard (square meter) for PAVEMENT REMOVAL.

**TEMPORARY INFORMATION SIGNING**
Effective: November 13, 1996 Revised: January 29, 2020

Description.
This work shall consist of furnishing, installing, maintaining, relocating for various states of construction and eventually removing temporary informational signs. Included in this item may be ground mount signs, skid mount signs, truss mount signs, bridge mount signs, and overlay sign panels which cover portions of existing signs.

Materials.
Materials shall be according to the following Articles of Section 1000 - Materials:

| | Item | Article/Section |
|---|---|---|
| a.) | Sign Base (Note 1) | 1090 |
| b.) | Sign Face (Note 2) | 1091 |
| c.) | Sign Legends | 1091 |
| d.) | Sign Supports | 1093 |
| e.) | Overlay Panels (Note 3) | 1090.02 |

Note 1. The Contractor may use 5/8 inch (16 mm) instead of 3/4 inch (19 mm) thick plywood.
Note 2. The sign face material shall be in accordance with the Department's Fabrication of Highway Signs Policy.
Note 3. The overlay panels shall be 0.08 inch (2 mm) thick.

## GENERAL CONSTRUCTION REQUIREMENTS

Installation.
The sign sizes and legend sizes shall be verified by the Contractor prior to fabrication.

Signs which are placed along the roadway and/or within the construction zone shall be installed according to the requirements of Article 701.14 and Article 720.04. The signs shall be 7 ft (2.1 m) above the near edge of the pavement and shall be a minimum of 2 ft (600 mm) beyond the edge of the paved shoulder. A minimum of two (2) posts shall be used.

The attachment of temporary signs to existing bridges, sign structures or sign panels shall be approved by the Engineer. Any damage to the existing signs and/or structures due to the Contractor's operations shall be repaired or signs replaced, as determined by the Engineer, at the Contractor's expense.

Method of Measurement.
This work shall be measured for payment in square feet (square meters) edge to edge (horizontally and vertically).

All hardware, posts or skids, supports, bases for ground mounted signs, connections, which are required for mounting these signs will be included as part of this pay item.

Basis Of Payment.
This work shall be paid for at the contract unit price per square foot (square meter) for TEMPORARY INFORMATION SIGNING.

**UNDERGROUND RACEWAYS**
Effective: March 1, 2015

Revise Article 810.04 of the Standard Specifications to read:

"Installation. All underground conduits shall have a minimum depth of 30-inches (700 mm) below the finished grade."

Add the following to Article 810.04 of the Standard Specifications:

"All metal conduit installed underground shall be Rigid Steel Conduit unless otherwise indicated on the plans."

Add the following to Article 810.04 of the Standard Specifications:

"All raceways which extend outside of a structure or duct bank but are not terminated in a cabinet, junction box, pull box, handhole, post, pole, or pedestal shall extend a minimum or 300 mm (12") or the length shown on the plans beyond the structure or duct bank. The end of this extension shall be capped and sealed with a cap designed for the conduit to be capped.

The ends of rigid metal conduit to be capped shall be threaded, the threads protected with full galvanizing, and capped with a threaded galvanized steel cap.

The ends of rigid nonmetallic conduit and coilable nonmetallic conduit shall be capped with a rigid PVC cap of not less than 3 mm (0.125") thick. The cap shall be sealed to the conduit using a room-temperature-vulcanizing (RTV) sealant compatible with the material of both the cap and the conduit. A washer or similar metal ring shall be glued to the inside center of the cap with epoxy, and the pull cord shall be tied to this ring."

**GENERAL ELECTRICAL REQUIREMENTS**

This special provision replaces Articles 801.01 – 801.07, 801.09 – 801-16 of the Standard Specifications.

**Definition.** Codes, standards, and industry specifications cited for electrical work shall be by definition the latest adopted version thereof, unless indicated otherwise.

Materials by definition shall include electrical equipment, fittings, devices, motors, appliances, fixtures, apparatus, all hardware and appurtenances, and the like, used as part of, or in connection with, electrical installation.

**Standards of Installation.** Materials shall be installed according to the manufacturer's recommendations, the NEC, OSHA, the NESC, and AASHTO's Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

All like materials shall be from the same manufacturer. Listed and labeled materials shall be used whenever possible. The listing shall be according to UL or an approved equivalent.

**Safety and Protection.** Safety and protection requirements shall be as follows.

Safety. Electrical systems shall not be left in an exposed or otherwise hazardous condition. All electrical boxes, cabinets, pole handholes, etc. which contain wiring, either energized or non-energized, shall be closed or shall have covers in place and be locked when possible, during nonworking hours.

Protection. Electrical raceway or duct openings shall be capped or otherwise sealed from the entrance of water and dirt. Wiring shall be protected from mechanical injury.

**Equipment Grounding Conductor.** All electrical systems, materials, and appurtenances shall be grounded. Good ground continuity throughout the electrical system shall be assured, even though every detail of the requirements is not specified or shown. Electrical circuits shall have a continuous insulated equipment grounding conductor. When metallic conduit is used, it shall be bonded to the equipment grounding conductor, but shall not be used as the equipment grounding conductor.

Detector loop lead-in circuits, circuits under 50 volts, and runs of fiber optic cable will not require an equipment grounding conductor.

Where connections are made to painted surfaces, the paint shall be scraped to fully expose metal at the connection point. After the connection is completed, the paint system shall be repaired to the satisfaction of the Engineer.

Bonding of all boxes and other metallic enclosures throughout the wiring system to the equipment grounding conductor shall be made using a splice and pigtail connection. Mechanical connectors shall have a serrated washer at the contact surface.

All connections to structural steel or fencing shall be made with exothermic welds. Care shall be taken not to weaken load carrying members. Where connections are made to epoxy coated reinforcing steel, the epoxy coating shall be sufficiently removed to facilitate a mechanical connection. The epoxy coating shall be repaired to the satisfaction of the Engineer. Where connections are made to insulated conductors, the connection shall be wrapped with at least four layers of electrical tape extended 6 in. (150 mm) onto the conductor insulation.

**Submittals.** At the preconstruction meeting, the Contractor shall submit a written listing of manufacturers for all major electrical and mechanical items. The list of manufacturers shall be binding, except by written request from the Contractor and approval by the Engineer. The request shall include acceptable reasons and documentation for the change.

Major items shall include, but not limited to the following:

| **Type of Work (discipline)** | **Item** |
|---|---|
| All Electrical Work | Electric Service Metering<br>Emergency Standby System<br>Transformers<br>Cable<br>Unit Duct<br>Splices<br>Conduit<br>Surge Suppression System |
| Lighting | Tower<br>Pole<br>Luminaire<br>Foundation<br>Breakaway Device<br>Controllers<br>Control Cabinet and Peripherals |
| ITS | Controller Cabinet and Peripherals<br>CCTV Cameras<br>Camera Structures<br>Ethernet Switches<br>Detectors<br>Detector Loop<br>Fiber Optic Cable |

Within 30 calendar days after contract execution, the Contractor shall submit, for approval, one copy each of the manufacturer's product data (for standard products and components) and detailed shop drawings (for fabricated items). Submittals for the materials for each individual pay item shall be complete in every respect. Submittals which include multiple pay items shall have all submittal material for each item or group of items covered by a particular specification, grouped together and the applicable pay item identified. Various submittals shall, when taken together, form a complete coordinated package. A partial submittal will be returned without review unless prior written permission is obtained from the Engineer.

The submittal shall be properly identified by route, section, county, and contract number.

The Contractor shall have reviewed the submittal material and affixed his/her stamp of approval, with date and signature, for each individual item. In case of subcontractor submittal, both the subcontractor and the Contractor shall review, sign, and stamp their approval on the submittal.

Illegible print, incompleteness, inaccuracy, or lack of coordination will be grounds for rejection.

**Items from multiple disciplines shall not be combined on a single submittal and transmittal. Items for lighting, signals, surveillance and CCTV must be in separate submittals since they may be reviewed by various personnel in various locations**.

The Engineer will review the submittals for conformance with the design concept of the project according to Article 105.04 and the following. The Engineer will stamp the drawings indicating their status as "Approved", "Approved as Noted", "Disapproved", or "Information Only". Since the Engineer's review is for conformance with the design concept only, it shall be the Contractor's responsibility to coordinate the various items into a working system as specified. The Contractor shall not be relieved from responsibility for errors or omissions in the shop, working, or layout drawings by the Engineer's approval thereof. The Contractor shall still be in full compliance with contract and specification requirements.

All submitted items reviewed and marked "Disapproved" or "Approved as Noted" shall be resubmitted by the Contractor in their entirety, unless otherwise indicated within the submittal comments.

Work shall not begin until the Engineer has approved the submittal. Material installed prior to approval by the Engineer, will be subject to removal and replacement at no additional cost to the Department.

Unless otherwise approved by the Engineer, all of the above items shall be submitted to the Engineer at the same time. Each item shall be properly identified by route, section, and contract number.

**Certifications.** When certifications are specified and are available prior to material manufacture, the certification shall be included in the submittal information. When specified and only available after manufacture, the submittal shall include a statement of intent to furnish certification. All certificates shall be complete with all appropriate test dates and data.

**Authorized Project Delay.** See Article 801.08

**Maintenance transfer and Preconstruction Inspection**:

General. Before performing any excavation, removal, or installation work (electrical or otherwise) at the site, the Contractor shall request a maintenance transfer and preconstruction site inspection, to be held in the presence of the Engineer and a representative of the party or parties responsible for maintenance of any lighting and/or traffic control systems which may be affected by the work. The request for the maintenance transfer and preconstruction inspection shall be made no less than seven (7) calendar days prior to the desired inspection date. The maintenance transfer and preconstruction inspection shall:

Establish the procedures for formal transfer of maintenance responsibility required for the construction period.

Establish the approximate location and operating condition of lighting and/or traffic control systems which may be affected by the work

Marking of Existing Cable Systems. The party responsible for maintenance of any existing lighting and/or traffic control systems at the project site will, at the Contractor's request, mark and/or stake, once per location, all underground cable routes owned or maintained by the State. A project may involve multiple "locations" where separated electrical systems are involved (i.e. different controllers). The markings shall be taken to have a horizontal tolerance of at least 304.8 mm (one (1) foot) to either side.. The request for the cable locations and marking shall be made at the same time the request for the maintenance transfer and preconstruction inspection is made. The Contractor shall exercise extreme caution where existing buried cable runs are involved. The markings of existing systems are made strictly for assistance to the Contractor and this does not relieve the Contractor of responsibility for the repair or replacement of any cable run damaged in the course of his work, as specified elsewhere herein. Note that the contractor shall be entitled to only one request for location marking of existing systems and that multiple requests may only be honored at the contractor's expense. No locates will be made after maintenance is transferred, unless it is at the contractor's expense.

Condition of Existing Systems. The Contractor shall conduct an inventory of all existing electrical system equipment within the project limits, which may be affected by the work, making note of any parts which are found broken or missing, defective or malfunctioning. Megger and load readings shall be taken for all existing circuits which will remain in place or be modified. If a circuit is to be taken out in its entirety, then readings do not have to be taken. The inventory and test data shall be reviewed with and approved by the Engineer and a record of the inventory shall be submitted to the Engineer for the record. Without such a record, all systems transferred to the Contractor for maintenance during construction shall be returned at the end of construction in complete, fully operating condition."

**Marking Proposed Locations for Highway Lighting System.** The Contractor shall mark or stake the proposed locations of all poles, cabinets, junction boxes, pull boxes, handholes, cable routes, pavement crossings, and other items pertinent to the work. A proposed location inspection by the Engineer shall be requested prior to any excavation, construction, or installation work after all proposed installation locations are marked. Any work installed without location approval is subject to corrective action at no additional cost to the Department.

**Inspection of electrical work**. Inspection of electrical work shall be according to Article 105.12 and the following.

Before any splice, tap, or electrical connection is covered in handholes, junction boxes, light poles, or other enclosures, the Contractor shall notify and make available such wiring for the Engineer's inspection.

**Maintenance and Responsibility During Construction.**

Lighting Operation and Maintenance Responsibility. The scope of work shall include the assumption of responsibility for the continuing operation and maintenance of the existing, proposed, temporary, sign and navigation lighting, or other lighting systems and all appurtenances affected by the work as specified elsewhere herein. Maintenance of lighting systems is specified elsewhere and will be paid for separately

The proposed lighting system must be operational prior to opening the roadway to traffic unless temporary lighting exists which is designed and installed to properly illuminate the roadway.

Energy and Demand Charges. The payment of basic energy and demand charges by the electric utility for existing lighting which remains in service will continue as a responsibility of the Owner, unless otherwise indicated. Unless otherwise indicated or required by the Engineer duplicate lighting systems (such as temporary lighting and proposed new lighting) shall not be operated simultaneously at the Owner's expense and lighting systems shall not be kept in operation during long daytime periods at the Owner's expense. Upon written authorization from the Engineer to place a proposed new lighting system in service, whether the system has passed final acceptance or not, (such as to allow temporary lighting to be removed), the Owner will accept responsibility for energy and demand charges for such lighting, effective the date of authorization. All other energy and demand payments to the utility shall be the responsibility of the Contractor until final acceptance.

**Damage to Electrical Systems.** Should damage occur to any existing electrical systems through the Contractor's operations, the Engineer will designate the repairs as emergency or non-emergency in nature.

Emergency repairs shall be made by the Contractor, or as determined by the Engineer, the Department, or its agent. Non-emergency repairs shall be performed by the Contractor within six working days following discovery or notification. All repairs shall be performed in an expeditious manner to assure all electrical systems are operational as soon as possible. The repairs shall be performed at no additional cost to the Department.

Lighting. An outage will be considered an emergency when three or more lights on a circuit or three successive lights are not operational. Knocked down materials, which result in a danger to the motoring public, will be considered an emergency repair.

Temporary aerial multi-conductor cable, with grounded messenger cable, will be permitted if it does not interfere with traffic or other operations, and if the Engineer determines it does not require unacceptable modification to existing installations.

**Testing.** Before final inspection, the electrical work shall be tested. Tests may be made progressively as parts of the work are completed, or may be made when the work is complete. Tests shall be made in the presence of the Engineer. Items which fail to test satisfactorily shall be repaired or replaced. Tests shall include checks of control operation, system voltages, cable insulation, and ground resistance and continuity.

The forms for recording test readings will be available from the Engineer in electronic format. The Contractor shall provide the Engineer with a written report of all test data including the following:

- Voltage Tests
- Amperage Tests
- Insulation Resistance Tests
- Continuity tests
- Detector Loop Tests

Lighting systems. The following tests shall be made.

(1) Voltage Measurements. Voltages in the cabinet from phase to phase and phase to neutral, at no load and at full load, shall be measured and recorded. Voltage readings at the last termination of each circuit shall be measured and recorded.

(2) Insulation Resistance. Insulation resistance to ground of each circuit at the cabinet, with all loads connected, shall be measured and recorded.

On tests of new cable runs, the readings shall exceed 50 megohms for phase and neutral conductors with a connected load over 20 A, and shall exceed 100 megohms for conductors with a connected load of 20 A or less.

On tests of cable runs which include cables which were existing in service prior to this contract, the resistance readings shall be the same or better than the readings recorded at the maintenance transfer at the beginning of the contract. Measurements shall be taken with a megohm meter approved by the Engineer.

(3) Loads. The current of each circuit, phase main, and neutral shall be measured and recorded. The Engineer may direct reasonable circuit rearrangement. The current readings shall be within ten percent of the connected load based on material ratings.

(4) Ground Continuity. Resistance of the system ground as taken from the farthest extension of each circuit run from the controller (i.e. check of equipment ground continuity for each circuit) shall be measured and recorded. Readings shall not exceed 2.0 ohms, regardless of the length of the circuit.

(5) Resistance of Grounding Electrodes. Resistance to ground of all grounding electrodes shall be measured and recorded. Measurements shall be made with a ground tester during dry soil conditions as approved by the Engineer. Resistance to ground shall not exceed 10 ohms.

ITS. The following test shall be made in addition to the lighting system test above.

Detector Loops. Before and after permanently securing the loop in the pavement, the resistance, inductance, resistance to ground, and quality factor for each loop and lead-in circuit shall be tested. The loop and lead-in circuit shall have an inductance between 20 and 2500 microhenries. The resistance to ground shall be a minimum of 50 megohms under any conditions of weather or moisture. The quality factor (Q) shall be 5 or greater.

Fiber Optic Systems. Fiber optic testing shall be performed as required in the fiber optic cable special provision and the fiber optic splice special provision.

All test results shall be furnished to the Engineer seven working days before the date the inspection is scheduled.

**Contract Guarantee.** The Contractor shall provide a written guarantee for all electrical work provided under the contract for a period of six months after the date of acceptance with the following warranties and guarantees.

(a) The manufacturer's standard written warranty for each piece of electrical material or apparatus furnished under the contract. The warranty for light emitting diode (LED) modules, including the maintained minimum luminance, shall cover a minimum of 60 months from the date of delivery.

(b) The Contractor's written guarantee that, for a period of six months after the date of final acceptance of the work, all necessary repairs to or replacement of said warranted material or apparatus for reasons not proven to have been caused by negligence on the part of the user or acts of a third party shall be made by the Contractor at no additional cost to the Department.

(c) The Contractor's written guarantee for satisfactory operation of all electrical systems furnished and constructed under the contract for a period of six months after final acceptance of the work.

The warranty for an uninterruptable power supply (UPS) shall cover a minimum of two years from date the equipment is placed in operation; however, the batteries of the UPS shall be warranted for full replacement for a minimum of five years.

**Record Drawings.** Alterations and additions to the electrical installation made during the execution of the work shall be neatly and plainly marked in red by the Contractor on the full-size set of record drawings kept at the Engineer's field office for the project. These drawings shall be updated on a daily basis and shall be available for inspection by the Engineer during the course of the work. The record drawings shall include the following:

- Cover Sheet
- Summary of Quantities, electrical items only
- Legends, Schedules and Notes
- Plan Sheet
- Pertinent Details
- Single Line Diagram
- Other useful information useful to locate and maintain the systems.

Any modifications to the details shall be indicated. Final quantities used shall be indicated on the Summary of Quantities. Foundation depths used shall also be listed.

As part of the record drawings, the Contractor shall inventory all materials, new or existing, on the project and record information on inventory sheets provided by the Engineer.

The inventory shall include:

- Location of Equipment, including rack, chassis, slot as applicable.
- Designation of Equipment
- Equipment manufacturer
- Equipment model number
- Equipment Version Number
- Equipment Configuration
    - Addressing, IP or other
    - Settings, hardware or programmed
- Equipment Serial Number

The following electronic inventory forms are available from the Engineer:

- Lighting Controller Inventory
- Lighting Inventory
- Light Tower Inspection Checklist
- ITS Location Inventory

The information shall be entered in the forms; handwritten entries will not be acceptable; except for signatures. Electronic file shall also be included in the documentation.

When the work is complete, and seven days before the request for a final inspection, the set of contract drawings, stamped "**RECORD DRAWINGS**", shall be submitted to the Engineer for review and approval and shall be stamped with the date and the signature of the Contractor's supervising Engineer or electrician. The record drawings shall be submitted in PDF format on CDROM as well as hardcopy's for review and approval.

In addition to the record drawings, PDF copies of the final catalog cuts which have been Approved and Approved as Noted with applicable follow-up shall be submitted along with the record drawings. The PDF files shall clearly indicate either by filename or PDF table of contents the respective pay item number. Specific part or model numbers of items which have been selected shall be clearly visible. Hard copies of the catalog are not required with this submittal.

The Contractor shall provide two sets of electronically produced drawings in a moisture proof pouch to be kept on the inside door of the controller cabinet or other location approved by the Engineer. These drawings shall show the final as-built circuit orientation(s) of the project in the form of a single line diagram with all luminaires numbered and clearly identified for each circuit.

Final documentation shall be submitted as a complete submittal package, i.e. record drawings, test results, inventory, etc. shall be submitted at the same time. Partial piecemeal submittals will be rejected without review. A total of five hardcopies and CDROMs of the final documentation shall be submitted.

GPS Documentation. In addition to the specified record drawings, the Contactor shall record GPS coordinates of the following electrical components being installed, modified or being affected in other ways by this contract:

- All light poles and light towers.
- Handholes and vaults.
- Junction Boxes
- Conduit roadway crossings.
- Controllers.
- Control Buildings.
- Structures with electrical connections, i.e. DMS, lighted signs.
- Electric Service locations.
- CCTV Camera installations.
- Roadway Surveillance installations.
- Fiber Optic Splice Locations.
- Fiber Optic Cables. Coordinates shall be recorded along each fiber optic cable route every 200 feet.
- All fiber optic slack locations shall be identified with quantity of slack cable included. When sequential cable markings are available, those markings shall be documented as cable marking into enclosure and marking out of enclosure.

Datum to be used shall be North American 1983.

Data shall be provided electronically and in print form. The electronic format shall be compatible with MS Excel. Latitude and Longitude shall be in decimal degrees with a minimum of 6 decimal places. Each coordinate shall have the following information:

1. District
2. Description of item
3. Designation
4. Use
5. Approximate station
6. Contract Number
7. Date
8. Owner
9. Latitude
10. Longitude
11. Comments

A spreadsheet template will be available from the Engineer for use by the Contractor.

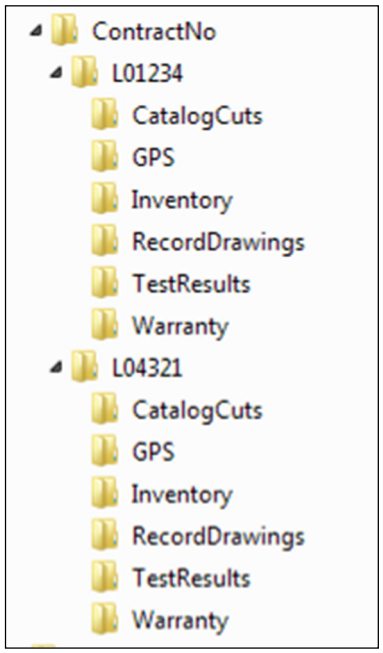
**Prior to the collection of data, the contractor shall provide a sample data collection of at least six data points of known locations to be reviewed and verified by the Engineer to be accurate within 20 feet.** Upon verification, data collection can begin. Data collection can be made as construction progresses, or can be collected after all items are installed. If the data is unacceptable the contractor shall make corrections to the data collection equipment and or process and submit the data for review and approval as specified. **Data collection prior to the submittal and review of the sample data of existing data points will be unacceptable and rejected.**

Accuracy. Data collected is to be mapping grade. A handheld mapping grade GPS device shall be used for the data collection. The receiver shall support differential correction and data shall have minimum 5 meter accuracy after post processing.

GPS receivers integrated into cellular communication devices, recreational and automotive GPS devices are not acceptable.

The GPS shall be the product of an established major GPS manufacturer having been in the business for a minimum of 6 years."

The documents on the CD shall be organized by the Electrical Maintenance Contract Management System (EMCMS) location designation. If multiple EMCMS locations are within the contract, separate folders shall be utilized for each location as follows:




Extraneous information not pertaining to the specific EMCMS location shall not be included in that particular folder and sub-folder.

The inspection will not be made until after the delivery of acceptable record drawings, specified certifications, and the required guarantees.

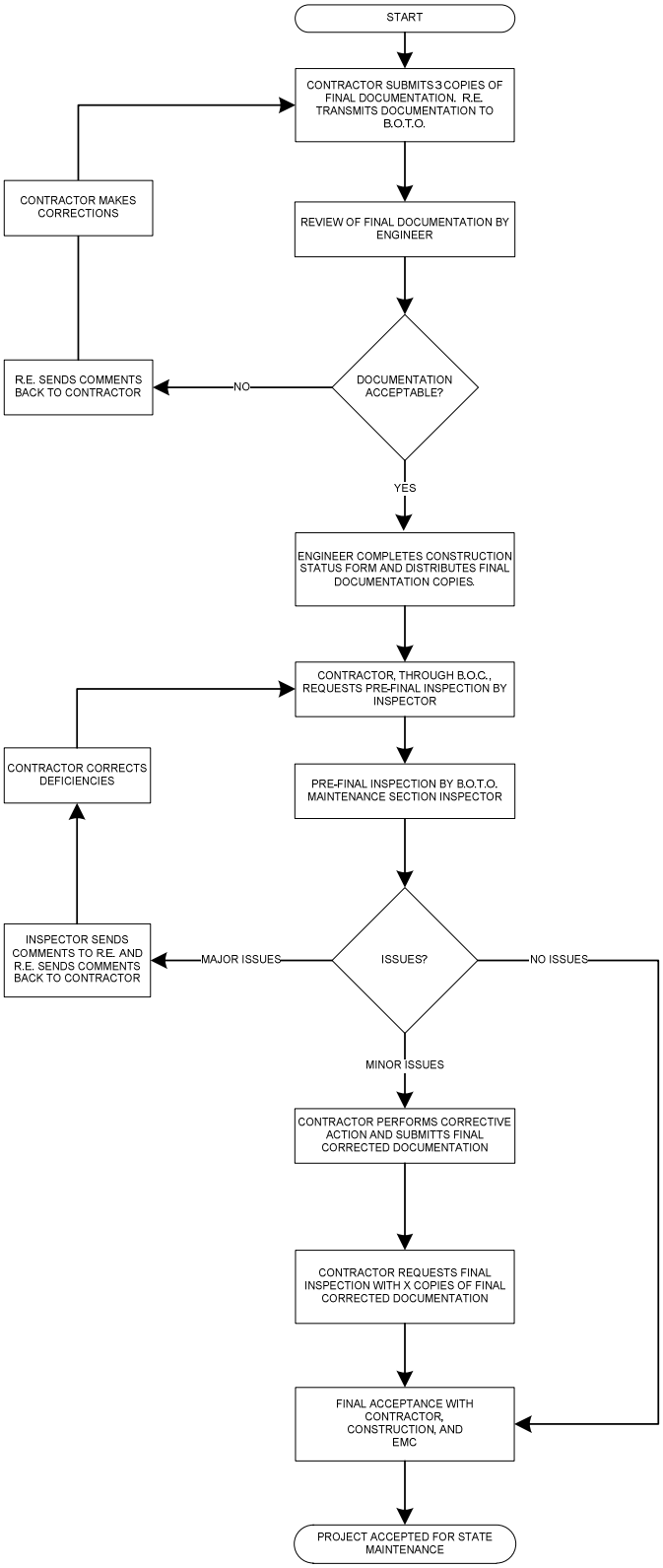
The Final Acceptance Documentation Checklist shall be completed and is contained elsewhere herein.

All CD's shall be labeled as illustrated in the CD Label Template contained herein.

**Acceptance.** Acceptance of electrical work will be given at the time when the Department assumes the responsibility to protect and maintain the work according to Article 107.30 or at the time of final inspection.

When the electrical work is complete, tested, and fully operational, the Contractor shall schedule an inspection for acceptance with the Engineer no less than seven working days prior to the desired inspection date. The Contractor shall furnish the necessary labor and equipment to make the inspection.

A written record of the test readings taken by the Contractor according to Article 801.13 shall be furnished to the Engineer seven working days before the date the inspection is scheduled. Inspection will not be made until after the delivery of acceptable record drawings, specified certifications, and the required guarantees.


START
CONTRACTOR SUBMITS 3 COPIES OF FINAL DOCUMENTATION. R.E. TRANSMITS DOCUMENTATION TO B.O.T.O.
REVIEW OF FINAL DOCUMENTATION BY ENGINEER
DOCUMENTATION ACCEPTABLE?
NO
R.E. SENDS COMMENTS BACK TO CONTRACTOR
CONTRACTOR MAKES CORRECTIONS
YES
ENGINEER COMPLETES CONSTRUCTION STATUS FORM AND DISTRIBUTES FINAL DOCUMENTATION COPIES.
CONTRACTOR, THROUGH B.O.C., REQUESTS PRE-FINAL INSPECTION BY INSPECTOR
PRE-FINAL INSPECTION BY B.O.T.O. MAINTENANCE SECTION INSPECTOR
ISSUES?
MAJOR ISSUES
INSPECTOR SENDS COMMENTS TO R.E. AND R.E. SENDS COMMENTS BACK TO CONTRACTOR
CONTRACTOR CORRECTS DEFICIENCIES
NO ISSUES
MINOR ISSUES
CONTRACTOR PERFORMS CORRECTIVE ACTION AND SUBMITTS FINAL CORRECTED DOCUMENTATION
CONTRACTOR REQUESTS FINAL INSPECTION WITH X COPIES OF FINAL CORRECTED DOCUMENTATION
FINAL ACCEPTANCE WITH CONTRACTOR, CONSTRUCTION, AND EMC
PROJECT ACCEPTED FOR STATE MAINTENANCE

**Final Acceptance Documentation Checklist**

| **LOCATION** | |
|---|---|
| Route | Common Name |
| Limits | Section |
| Contract # | County |
| Controller Designation(s) | EMC Database Location Number(s) |

| **ITEM** | **Contractor (Verify)** | **Resident Engineer (Verify)** |
|---|---|---|
| **Record Drawings**<br>-Four hardcopies (11" x 17")<br>-Scanned to two CD-ROMs | ☐<br>☐ | ☐<br>☐ |
| **Field Inspection Tests**<br>-Voltage<br>-Amperage<br>-Cable Insulation Resistance<br>-Continuity<br>-Controller Ground Rod Resistance<br>(Four Hardcopies & scanned to two CD's) | ☐<br>☐<br>☐<br>☐<br>☐ | ☐<br>☐<br>☐<br>☐<br>☐ |
| **GPS Coordinates**<br>**-**Excel file<br>(Check Special Provisions, Excel file scanned to two CD's) | ☐ | ☐ |
| **Job Warranty Letter**<br>(Four Hardcopies & scanned to two CD's) | ☐ | ☐ |
| **Catalog Cut Submittals**<br>-Approved & Approved as Noted<br>(Scanned to two CD's) | ☐ | ☐ |
| **Lighting Inventory Form**<br>(Four Hardcopies & scanned to two CD's) | ☐ | ☐ |
| **Lighting Controller Inventory Form**<br>(Four Hardcopies & scanned to two CD's) | ☐ | ☐ |
| **Light Tower Inspection Form**<br>(If applicable, Four Hardcopies & scanned to two CD's) | ☐ | ☐ |

Four Hardcopies & scanned to two CD's shall be submitted for all items above. The CD ROM shall be labeled as shown in the example contained herein.

**General Notes:**

Record Drawings – The record drawings should contain contract cover sheet, summary of quantities showing all lighting pay item sheets, proposed lighting plans and lighting detail sheets. Submit hardcopies 11 x 17 size. Include the original "red-ink" copy. The red-ink markup should be neatly drawn. Record drawings copies should be legible. Blurred copies will not be acceptable. Temporary lighting plans and removal lighting plans should not be part of the set.

Field Inspection Tests – Testing should be done for proposed cables. Testing shall be per standard specifications. Forms shall be neatly filled out.

GPS Coordinates – Check special provisions "General Electrical Requirements". Submit electronic "EXCEL" file.

Job Warranty Letter – See standard specifications.

Cutsheet Submittal – See special provisions "General Electrical Requirements". Scan Approved and Approved as Noted cutsheets.

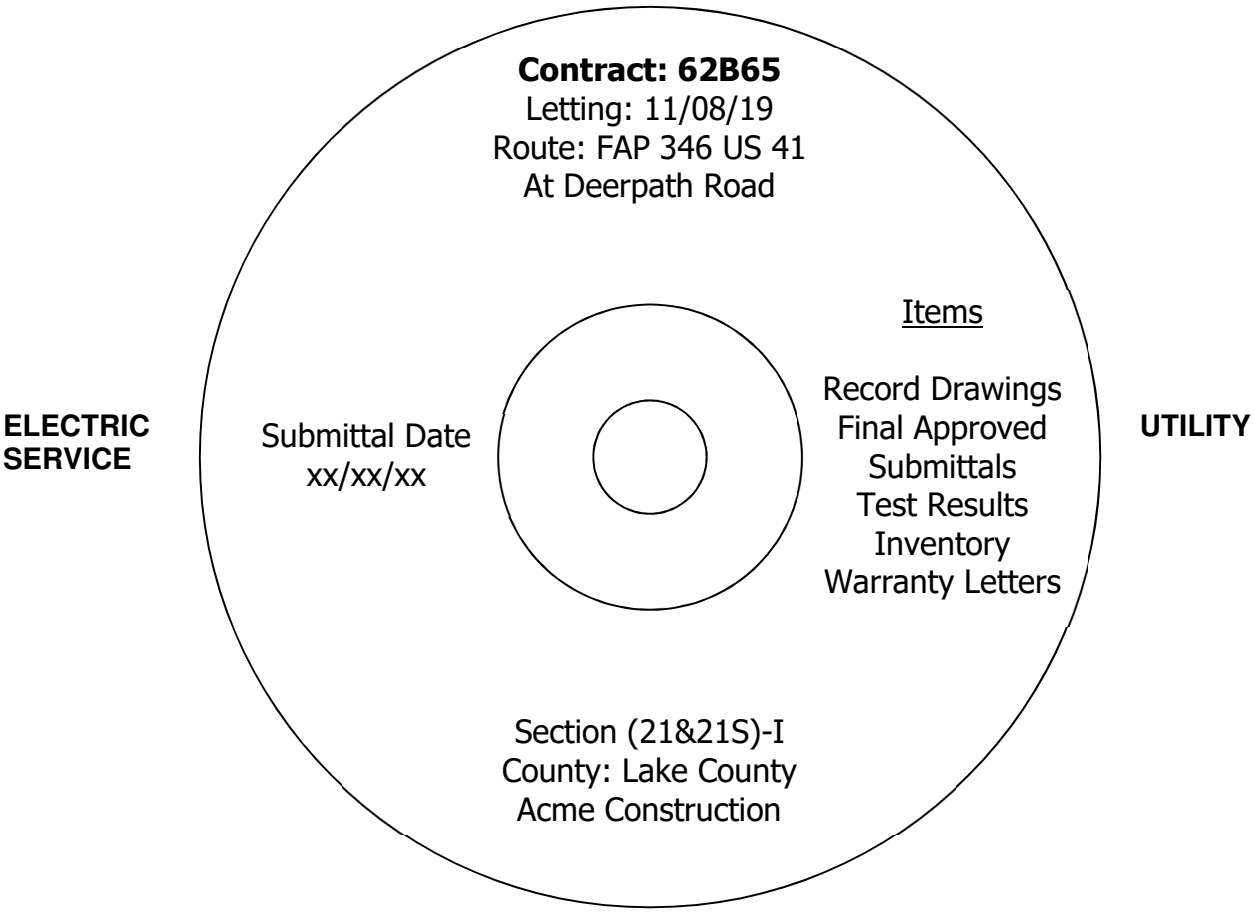
Lighting Inventory Form – Inventory form should include only proposed light poles, proposed light towers, proposed combination (traffic/light pole) lighting and proposed underpass luminaires.

Lighting Controller Inventory Form – Form should be filled out for only proposed lighting controllers.

Light Tower Safety Inspection Form – Form should be filled out for each proposed light tower.

CD LABEL FORMAT TEMPLATE.

**Label must be printed; hand written labels are unacceptable and will be rejected.**



**ELECTRIC UTILITY SERVICE CONNECTION (COMED) January 1, 2012**
Effective: January 1, 2012

**Description.** This item shall consist of payment for work performed by ComEd in providing or modifying electric service as indicated. THIS MAY INVOLVE WORK AT MORE THAN ONE ELECTRIC SERVICE. For summary of the Electrical Service Drop Locations see the schedule contained elsewhere herein.

## CONSTRUCTION REQUIREMENTS

**General.** It shall be the Contractor's responsibility to contact ComEd. The Contractor shall coordinate his work fully with the ComEd both as to the work required and the timing of the installation. No additional compensation will be granted under this or any other item for extra work caused by failure to meet this requirement. **Please contact ComEd, New Business Center Call Center, at 866 NEW ELECTRIC (1-866-639-3532) to begin the service connection process. The Call Center Representatives will create a work order for the service connection. The representative will ask the requestor for information specific to the request. The representative will assign the request based upon the location of project.**

The Contractor should make particular note of the need for the earliest attention to arrangements with ComEd for service. In the event of delay by ComEd, no extension of time will be considered applicable for the delay unless the Contractor can produce written evidence of a request for electric service within 30 days of execution.

**Method Of Payment.** The Contractor will be reimbursed to the exact amount of money as billed by ComEd for its services. Work provided by the Contractor for electric service will be paid separately as described under ELECTRIC SERVICE INSTALLATION. No extra compensation shall be paid to the Contractor for any incidental materials and labor required to fulfill the requirements as shown on the plans and specified herein.

For bidding purposes, this item shall be estimated as $15,000

**Basis Of Payment.** This work will be paid for at the contract lump sum price for **ELECTRIC UTILITY SERVICE CONNECTION** which shall be reimbursement in full for electric utility service charges.

**SPECIAL PROVISIONS FOR CIVIL ITEMS**
**EROSION CONTROL BLANKET**

This work shall be done in accordance with the applicable portions of Section 251 of the Standard Specification except as modified herein:

Revise the first sentence of the first paragraph of Article 251.04 to read as follows:

> "**251.04 Erosion Control Blanket.** Erosion control blanket shall be placed using a knitted straw blanket."

Revise the second sentence of the second paragraph of Article 251.04 to read as follows:

> "The knitted straw blanket shall be placed so that the netting is on top and the fibers are in contact with the soil."

**STORM SEWERS, RUBBER GASKET**

Description. This work shall consist of furnishing all material, equipment and labor for storm sewer lines with rubber gasketed joints at the locations shown on the plans or as directed by the Engineer, in accordance with Section 550 of the Standard Specifications, except as modified herein.

Storm sewer with rubber gasketed joints shall be used at all locations where proposed storm sewer crosses either existing water main to remain or proposed water main, regardless of vertical separation. The entire run of sewer shall use rubber gaskets and a water tight connection to both upstream and downstream structures shall be made to the approval of the engineer.

This item shall only be used for storm sewer runs which cross either over or under active water mains. For sections where storm sewer and water main run parallel to each other with less than 10 feet of horizontal clearance, use pay item STORM SEWERS, RUBBER GASKET of the diameter specified.

Materials. Storm sewers shall be made of concrete as described in Section 1042 in the Standards Specifications. Rubber gaskets shall be according to Section 1056 of the Standard Specifications. Storm sewer lines shall be of the diameter shown on the plans.

Basis of Payment. This work will be paid at the contract unit price per foot for STORM SEWERS, RUBBER GASKET, of the class, type, and size specified. Payment shall be full compensation for excavation, removal of spoils, water tight connections to structures, and all labor materials, equipment and incidentals as shown on the plans and as specified herein to provide a working system.

**STORM SEWERS JACKED IN PLACE, 54"**

Description. This work shall conform to Article 552 of the Standard Specifications except as herein modified:

General. Metal liner and concrete end collars are required. A steel casing of 72 in. diameter shall be installed. The strength and thickness of the steel casing, and the class, strength and joints of the 54 in diameter reinforced concrete carrier pipe shall be in accordance with Union Pacific Rail Road Storm Sewer Jacking requirements. The ends of the casing pipe shall be sealed with a concrete collar as shown in the details. See Union Pacific Rail Road Storm Sewer Jacking Requirements Details in the plans for all requirements.

Track and Ground monitoring of the area around the pipe jacking within the Union Pacific Right of Way will be required. This work shall be as described in the specification for "Track and Ground Monitoring".

Basis of Payment. This work will be paid for at the contract unit price per foot of STORM SEWERS JACKED IN PLACE, 54". This price shall include all costs for the excavation, work pits, receiving pits, dewatering, sheeting, bracing, backfilling, caps, plugs, grout, spacers, lubricants, drilling fluids, auguring, concrete collars, reinforcement material, and disposal of the augured material, steel casing pipe, and all other labor, equipment, and materials necessary to install the work as specified. All work required for Track and Ground Monitoring shall be included in the cost of Storm Sewer Jacked In Place, 54".

**DUCTILE IRON WATER MAIN**

Description. This work shall consist of constructing Class 52 Ductile Iron Water Main at the locations shown on the plans. The material and installation requirements shall conform to the Water Distribution standards following this section and City of Lake Forest requirements. The pay item shall include the following items:

1) Saw cutting full depth any abutting pavement to remain.
2) The excavating, transportation and disposal of surplus material and debris.
3) Notifying residents of scheduled or emergency loss of water service including notification and coordination with the City of Lake Forest.
4) Installation of ductile iron water main pipe of the size specified, including connections to the existing water main.
5) Furnishing and installing required sleeves, saddles, reducers, fittings, bends, restraint devices and thrust blocking.
6) Installing tracing wire, connectors and access boxes.
7) Hydrostatic testing and disinfection of mains and appurtenances.

Method of Measurement. This work will be measured for payment in place in linear feet on a straight horizontal line along the centerline of the water main.

Basis of Payment. This work will be paid for at the contract unit price per linear foot for DUCTILE IRON WATER MAIN, of the diameter specified.

**WATER VALVES 12”**

Description. This work shall consist of constructing water valves at the locations shown on the plans. The material and installation requirements shall conform to the Water Distribution standards following this section and City of Lake Forest requirements. The pay item shall include furnishing and installing required valves, sleeves, reducers, fittings, restraints, and thrust blocking as detailed.

Method of Measurement. This work will be measured for payment in place for each Water Valve installed.

Basis of Payment. This work will be paid for at the contract unit price per each for WATER VALVES 12”.

**ADJUSTING WATER MAIN**

Description. This work shall consist of removing and relocating existing water main per the plan details to avoid conflicts with proposed storm sewer. Proposed storm sewer crossing over adjusted water main shall be water main quality pipe. The pay item shall include the following items:

1. Saw cutting full depth any abutting pavement to remain.
2. The excavating, transportation and disposal of surplus material and debris.
3. Notifying residents of scheduled or emergency loss of water service including notification and coordination with the City of Lake Forest.
4. Sawcut and removal of existing watermain.
5. Installation of ductile iron water main pipe of the size specified, including connections to the existing water main.
6. Furnishing and installing required sleeves, saddles, reducers, fittings, bends, restraint devices and thrust blocking.
7. Mains and appurtenances shall be cleaned and swabbed during installation. Upon completion of the adjustment the line shall be flushed at a velocity no greater than 2.5 feet per second.

Method of Measurement. This work will be measured for payment in place in linear feet on a straight horizontal line along the centerline of the adjusted water main.

Basis of Payment. This work will be paid for at the contract unit price per linear foot for ADJUSTING WATER MAIN, of the diameter specified.

**WATER SERVICE LINE 1 1/2"**

Description. This work shall consist of constructing Type K Copper Water Service piping at the locations shown on the plans. No unions or couplings are allowed unless the length is in excess of 100 feet. The pay item shall include the following items:

1. Saw cutting full depth any abutting pavement to remain.
2. The excavating, transportation and disposal of surplus material and debris.

3. Installing water service by means of directional drilling or an open trench, including installation of a corporation stop with eighth or quarter bend tailpiece, Mueller H-15010 or H-15020 or approved equal.
4. Installing a curb box at the location indicated in the plans. Curb box shall be Minneapolis Type, Mueller 10304, 2" minimum diameter on 1-1/2" roundway per Lake Forest Standard 5.04.

Method of Measurement. This work will be measured for payment in place in linear feet on a straight horizontal line along the centerline of the water service.

Basis of Payment. This work will be paid for at the contract unit price per linear foot for WATER SERVICE LINE 1 ½".

**VALVE VAULTS, TYPE A, 5'-DIAMETER, TYPE 1 FRAME, CLOSED LID**

Description. This work shall consist of constructing valve vaults at the locations shown on the plans. The material and installation requirements shall conform to the Water Distribution standards following this section and City of Lake Forest requirements. The pay item shall include the following items:

1. Saw cutting full depth any abutting pavement to remain.
2. The excavating, transportation and disposal of excavated material & construction debris.
3. Furnishing & installing pre-cast valve vault as shown on the plans or as directed by the Engineer.

Method of Measurement. This work will be measured for payment in place for each valve vault installed.

Basis of Payment. This work will be paid for at the contract unit price per each for VALVE VAULTS, TYPE A, 5' DIAMETER, TYPE 1 FRAME, CLOSED LID.

## WATER DISTRIBUTION

### PART 1 – GENERAL

1.1 DESCRIPTION

a. REPLACE EXISTING WATERMAINS AS SHOWN ON DRAWINGS INCLUDING ALL REQUIRED FITTINGS, BLOCKING OF BENDS AND SPECIFIED BEDDING, BACKFILL AND TRACING WIRE.

1.2 QUALITY ASSURANCE

a. REFERENCE STANDARD:
   i. AMERICAN WATER WORKS ASSOCIATION (AWWA):
      1. AWWA C104/A21.4 – AWWA STANDARD FOR CEMENT-MORTAR LINING FOR DUCTILE-IRON PIPE AND FITTINGS (CURRENT EDITION)
      2. AWWA C105/A21.5 – AMERICAN NATIONAL STANDARD FOR POLYETHYLENE ENCASEMENT FOR DUCTILE-IRON PIPE SYSTEMS
      3. AWWA C110/A21.10 – AMERICAN NATIONAL STANDARD FOR DUCTILE-IRON AND GRAY-IRON FITTINGS FOR WATER (CURRENT EDITION) AND/OR AWWA C153/A21.53 – DUCTILE IRON COMPACT FITTINGS FOR WATER SERVICE (CURRENT EDITION)
      4. AWWA C111/A21.11 – AMERICAN NATIONAL STANDARD FOR RUBBER-GASKET JOINTS FOR DUCTILE-IRON PRESSURE PIPE AND FITTINGS (CURRENT EDITION).
      5. AWWA C115/A21.15 – STANDARD FOR FLANGED DUCTILE-IRON PIPE WITH DUCTILE-IRON OR GRAY-IRON THREADED FLANGES (CURRENT EDITION)
      6. AWWA C150/A21.50 – AWWA STANDARD FOR THICKNESS DESIGN OF DUCTILE-IRON PIPE (CURRENT EDITION).
      7. AWWA C151/A21.51 – AMERICAN NATIONAL STANDARD FOR DUCTILE-IRON PIPE, CENTRIFUGALLY CAST, FOR WATER (CURRENT EDITION).
      8. AWWA C500 – STANDARD FOR METAL-SEATED GATE VALVES FOR WATER SUPPLY SERVICE (CURRENT EDITION)
      9. AWWA C600 – AWWA STANDARD FOR INSTALLATION OF DUCTILE-IRON WATER MAINS AND THEIR APPURTENANCES (CURRENT EDITION).
      10. AWWA C651 – AWWA STANDARD FOR DISINFECTING WATER MAINS (CURRENT EDITION).
      11. AWWA C909 – AWWA STANDARD FOR MOLECULARLY ORIENTED POLYVINYL CHLORIDE (PVCO) PRESSURE PIPE, 4 IN. THROUGH 12 IN. (100 MM THROUGH 600 MM), FOR WATER DISTRIBUTION (CURRENT EDITION).

   ii. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):
      1. ASTM B88 – STANDARD SPECIFICATION FOR SEAMLESS COPPER WATER TUBE (CURRENT EDITION).
   iii. ILLINOIS STATE PLUMBING CODE, (CURRENT EDITION).
   iv. ILLINOIS DEPARTMENT OF TRANSPORTATION (IDOT):
      1. STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, (CURRENT EDITION), (IDOTSPECS)

v. The City of Lake Forest Engineering and Construction Standards, (Current Edition).
vi. Standard Specifications for water and sewer main construction in Illinois.

**PART 2 - PRODUCTS**

2.1 Water Main

a. Conform to AWWA C151/A21.51 or AWWA C909/CIOD.
b. Minimum Thickness:
   i. Class 52 standard thickness for mechanical and push-on joint DIP.
   ii. Class 150 psi for C909/CIOD.
c. Push-On Joints:
   i. Provide in accordance with AWWA C111/A21.11.
d. Fittings:
   i. Provide fittings required to provide complete and operational system.
   ii. Provide restrained mechanical joint fittings.
   iii. Fittings may be ductile or cast iron in accordance with AWWA C110/A21.10 and AWWA C151/A21.51.
   iv. Fitting Pressure Rating: 250 psi.

e. Retainer glands for mechanical joint fittings except couplings:
   i. EBBA Iron Megalug or equal in strength and restraining ability.
f. Couplings for connecting new watermains to existing watermains:
   i. Ductile iron full body mechanical joint.
   ii. Must meet requirements of AWWA C110/A21.10.
   iii. Some existing watermains may have non-standard external diameters, measure existing mains prior to ordering couplings.
g. Tie rods and bands for restraining couplings:
   i. Steel or malleable iron.
   ii. Corrosion resistant alloy or coated to resist corrosion.
   iii. Rod diameter: 3/4-inch minimum.
   iv. Sufficient in strength and restraining ability to resist working pressures, test pressures, and surge pressures in watermains.
h. Polyethylene Encasement:
   i. The material and installation of the polyethylene encasement shall be as required in AWWA C105/A21.5.

2.2 Copper Service Pipe

a. Conform to ASTM B88.
b. Water service piping is to be 1 1/2" (min.) type "K" copper with no unions or couplings allowed unless length is in excess of 100 feet.
c. Fittings:
   i. Copper.
   ii. Compression type.

2.3 Service Connections

a. Corporation stops are to be Mueller H-15020.
b. Curb stops are to be Mueller H-15154 Minneapolis pattern.
c. Curb boxes are to be Mueller 10304, Minneapolis pattern, 2" diameter, minimum 5 1/2 to 6 foot depth. Requires Mueller bushing H-10343 when used on 1-1/2" roundway.

2.4 VALVES

a. MUELLER OR CLOW RESILIENT WEDGE OR EQUAL.
    i. END CONNECTIONS SHALL BE MECHANICAL JOINTS.

2.5 THRUST BLOCKS

a. PER LAKE FOREST STANDARD 5.08.

2.6 FIRE HYDRANTS

a. ALL FIRE HYDRANTS FURNISHED AND INSTALLED SHALL FULFILL ALL REQUIREMENTS OF THE STANDARD SPECIFICATIONS FOR FIRE HYDRANTS ADOPTED BY THE AMERICAN WATER WORKS ASSOCIATION ON JUNE 24, 1913, REVISED ON JUNE 6, 1916, AND AS SUBSEQUENTLY AMENDED. SAID HYDRANTS SHALL BE CATALOG NO. A-423, CENTURIAN MODEL, BREAK FLANGE, MANUFACTURED BY MUELLER COMPANY. EACH HYDRANT SHALL HAVE A 5 1/4 INCH PRINCIPAL VALVE OPENING, AND AN ATTACHED FLANGED GATE VALVE OPENING COUNTERCLOCKWISE. EACH HYDRANT CONNECTION PIPE SHALL HAVE AT LEAST 6 FEET OF COVER UNDER FINISHED GROUND AND PAVEMENT SURFACES. THE NET AREA OF THE HYDRANT, AT THE SMALLEST PART WHEN ITS VALVE IS OPENED WIDE, SHALL BE NO LESS THAN 120 PER CENT OF THE AREA OF THE VALVE OPENING. VALVE SEATS SHALL BE OF BRONZE OR OF OTHER SUITABLE NONCORRODIBLE METAL AND SHALL BE SECURELY FASTENED IN PLACE; THE FACE SHALL BE OF HIGH QUALITY RUBBER.
b. EACH FIRE HYDRANT FURNISHED BY THE CONTRACTOR SHALL BE PROVIDED WITH TWO (2) 2 1/2 INCH HOSE NOZZLES AND ONE (1) 4 ½" PUMPER NOZZLE OF BRONZE OR OTHER NONCORRODIBLE METAL. SAID NOZZLES SHALL BE THREADED WITH NATIONAL STANDARD THREAD FOR THE TYPE OF HOSE COUPLINGS NOW IN USE BY THE MUNICIPAL CORPORATION'S FIRE DEPARTMENT. EACH SUCH HYDRANT SHALL BE EQUIPPED WITH A POSITIVE ACTING RELIABLE DRIP VALVE FOR DRAINING THE STANDPIPE OF THE HYDRANT. EACH FIRE HYDRANT SHALL BE FURNISHED WITH A SIX (6) INCH CAST IRON BODY, BRONZE-MOUNTED AUXILIARY GATE VALVE, CATALOG NO. A-2380-18, MANUFACTURED BY MUELLER COMPANY AND ONE (1) OF THE TWO (2) VALVE BOXES SPECIFIED FOR MAIN VALVES. SAID AUXILIARY GATE VALVES SHALL MEET THE PRIOR REQUIREMENTS FOR GATE VALVES. ALL BOLTS BELOW GRADE SHALL BE STAINLESS STEEL.
c. EACH FIRE HYDRANT SHALL REST ON A FIRM FOUNDATION; A CONCRETE BLOCK SUPPORT AND WOOD BLOCKING ARE REQUIRED. THE CONTRACTOR SHALL FURNISH SUCH SUPPORT WITHOUT EXTRA CHARGE. THE CONTRACTOR SHALL PLACE 0.33 CUBIC YARDS OF COARSE CRUSHED STONE AROUND THE BASE OF EACH FIRE HYDRANT FOR DRAINAGE PURPOSES. THE FIRE HYDRANTS AND AUXILIARY VALVE BOXES ARE TO BE FURNISHED IN VARIABLE LENGTHS TO MEET THE HEIGHT REQUIREMENTS AS INDICATED IN THE ACCOMPANYING CONSTRUCTION PLANS.

2.7 TRACING WIRE FOR ALL WATER MAIN INSTALLATIONS

a. REINFORCED TRACER WIRE SHALL BE REQUIRED ON ALL NEW WATERMAINS INSTALLED WITHIN THE CITY (REGARDLESS OF PIPE MATERIAL). WIRE SHALL BE COPPER CLAD STEEL, # 12 AWG, WITH A MINIMUM AVERAGE TENSILE BREAK LOAD OF 1150 POUNDS AND A MINIMUM OF .045" BLUE HDPE INSULATION, (COPPERHEAD INDUSTRIES 1245B-EHS OR APPROVED EQUAL).
b. TWO SEPARATE CONDUCTORS SHALL BE RUN ALONG THE SIDE (AT THE NINE OR THREE O'CLOCK POSITION) OF ALL NEW MAINS AND HYDRANT LEADS, TAPED TO THE PIPE A MINIMUM OF EVERY 5 FEET. THE WIRE SHALL BE BROUGHT TO GRADE IN A TRACER BOX AT EACH HYDRANT AND SECURED TO THE TOP (INSIDE) OF EACH VALVE VAULT, LEAVE ENOUGH SLACK IN THE WIRE SO THAT IT MAY BE PULLED OUT OF THE VALVE VAULT.
c. A MAGNETIZED TRACER BOX SHALL BE INSTALLED AT EACH NEW FIRE HYDRANT. LOCATE THE BOX ADJACENT TO THE AUXILIARY VALVE, WITHIN TWO FEET OF THE HYDRANT BARREL. THE BOX SHALL BE TAMPER-PROOF, WITH CAST OR DUCTILE IRON BLUE LID WITH A BRASS WIRE HARNESS AND EXTERNAL BRASS CONNECTION SCREW, (COPPERHEAD INDUSTRIES, LD14-ADJ-B OR LDXL36-B IN UNPAVED AREAS, CD14-B FOR CONCRETE APPLICATIONS AND RB14-B IN ROADWAYS OR APPROVED EQUAL. ADDITIONAL TRACER BOXES MAYBE REQUIRED AT LOCATIONS TO BE DETERMINED BY THE CITY ENGINEER'S OFFICE.
d. ALL SPLICES IN THE WIRE FOR LATERAL RUNS OR HYDRANT LEADS SHALL BE MADE WITH A 3 - WAY ENCLOSED LUG DIRECT BURY CONNECTOR WITH INTERNAL SILICONE SEALANT (COPPERHEAD INDUSTRIES "DRYCONN" DIRECT BURY LUG, # 3WB-01 OR APPROVED EQUAL). IN DIRECTIONAL BORE OPERATIONS, SPLICES SHALL BE AT VALVE AND FITTING LOCATIONS WHERE EXCAVATION IS REQUIRED. IF A SPLICE MUST BE DONE IN AN UNEXCAVATED LOCATION, USE A WIRE NUT TWIST CONNECTOR WITH RESTRAINING CAP AND INTERNAL SILICONE SEALANT (COPPERHEAD INDUSTRIES #SCB – 01SR OR APPROVED EQUAL). WRAP CONNECTION AND WIRE (MINIMUM THREE INCHES EACH SIDE OF CONNECTION) WITH ELECTRICAL TAPE.
e. THE CONTRACTOR IS RESPONSIBLE FOR TESTING AND ENSURING THE CONTINUITY OF THE TRACING WIRE DURING INSTALLATION, THE CITY WILL TEST THE INTEGRITY OF THE TRACING WIRE AT THE END OF CONSTRUCTION.

## PART 3 – EXECUTION

3.1 INSTALLATION

a. INSTALL EXISTING WATERMAINS AS SHOWN ON THE DRAWINGS OR AS DIRECTED BY ENGINEER.
b. LOCATE WATERMAINS AND WATER SERVICE PIPES IN ACCORDANCE WITH SECTION 02220.
c. INSTALL WATERMAINS IN ACCORDANCE WITH AWWA C600, ILLINOIS STATE PLUMBING CODE, AND LOCAL MUNICIPALITY CODE.
d. TAKE CARE TO PREVENT DIRT OR OTHER DEBRIS FROM ENTERING WATER PIPING.
    i. PLUG END OF WATERMAIN PIPING WITH WATERTIGHT PLUG DURING STOPPAGES IN CONSTRUCTION DURING WORK DAY.
e. TRENCH (INCLUDING SHEETING SHORING AND BRACING AS NECESSARY TO BE COMPATIBLE WITH CONTRACTOR'S SPECIFIC CONSTRUCTION PROCEDURES) DEWATER, BED, COVER AND BACKFILL IN ACCORDANCE WITH SECTION 02220.
f. CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING ALL WATER SERVICES AND NOTIFYING CITY, RESIDENCE AND BUSINESSES, 2 WORKING DAYS (48 HOURS), PRIOR TO UTILITY OUTAGE.

g. ABANDON EXISTING WATERMAIN - EXISTING WATER MAIN SHALL BE CUT AND PLUGGED WHERE SHOWN ON THE DRAWINGS OR AS DIRECTED BY THE ENGINEER. EXISTING VALVES AND VALVE BOXES SHALL BE REMOVED AND THE EXISTING MAIN CUT AND PLUGGED WHERE SHOWN ON THE DRAWINGS OR DIRECTED BY THE ENGINEER. EXISTING VALVE VAULT ABANDONMENT SHOULD CONSIST OF THE REMOVAL AND DISPOSAL OF THE CONE SECTION. FRAME AND COVER SHALL BE SALVAGED FOR PICK UP BY THE CITY. STRUCTURES SHOULD BE FILLED WITH FA – 6 TO FULL DEPTH. EXCAVATION SHOULD BE FILLED AS REQUIRED AND THE SURFACE RESTORED TO MATCH EXISTING OR BETTER CONDITIONS.

3.2 FIELD TESTING

a. CONDUCT PRESSURE AND LEAKAGE TESTS IN ACCORDANCE WITH HYDROSTATIC TESTING SECTION OF AWWA C600, THESE SPECIFICATIONS, AND ILLINOIS STATE PLUMBING CODE.
b. COMMENCE TEST PROCEDURES ONLY WHEN FOLLOWING CONDITIONS MET:
    i. PIPE SECTION TO BE TESTED IS CLEAN AND FREE OF DIRT, SAND OR OTHER FOREIGN MATERIAL.
    ii. PIPE OUTLETS PLUGGED WITH TEST PLUGS. PLUGS, PIPES, FITTINGS, AND VALVES SECURED TO PREVENT BLOWOUTS.
    iii. VALUE OF APPLIED TEST PRESSURE CHECKED AT EACH POINT IN TEST SECTION ENSURING DOES NOT EXCEED MAXIMUM ALLOWABLE PRESSURE OF PIPES, VALVES, FITTINGS, AND APPURTENANCES.
c. SAFETY:
    i. PERFORM PRESSURE TESTING IN ACCORDANCE WITH OSHA REQUIREMENTS AND IN SUCH A MANNER PROTECTING WORKERS, BYSTANDERS, AND ADJACENT PROPERTY.
d. CORRECT LEAKS AND DEFECTS, RETEST UNTIL ACCEPTABLE TEST IS OBTAINED.

3.3 HYDROSTATIC TEST REQUIREMENTS

a. THE COMPLETED MAINS AND APPURTENANCES OF THE WATER DISTRIBUTION IMPROVEMENT SHALL BE TESTED, TO THE SATISFACTION OF THE ENGINEER AND ALSO OF THE MUNICIPAL CORPORATION, UNDER A PRESSURE OF 150 POUNDS PER SQUARE INCH FOR A PERIOD OF ONE (1) HOUR. WHERE LOCAL CONDITIONS PERMIT, THE TESTING SHALL BE DONE BY SECTIONS OF WATERMAIN NOT EXCEEDING 2,000 FEET IN LENGTH BEFORE BACKFILLING IS BEGUN. THE CONTRACTOR SHALL FURNISH AND OPERATE ALL REQUIRED TESTING EQUIPMENT. UNDER THE AFOREMENTIONED TEST PRESSURE OF 150 POUNDS PER SQUARE INCH, THE MAXIMUM ALLOWABLE LOSS OF WATER IN THE COMPLETED MAIN AND APPURTENANCES TO BE ACCEPTABLE SHALL NOT EXCEED THE FOLLOWING QUANTITIES PER HOUR PER 1,000 FEET FOR THE INDICATED PIPE DIAMETERS:

| PIPE DIAMETER IN INCHES | MAXIMUM ALLOWABLE LEAKAGE RATE IN GALLONS/HR. |
|---|---|
| 6 | 0.50 |
| 8 | 0.67 |
| 10 | 0.84 |
| 12 | 1.01 |
| 14 | 1.18 |
| 20 | 1.68 |
| 24 | 2.01 |

ALL VISIBLE LEAKS AT EXPOSED JOINTS AND ALL LEAKS EVIDENT ON THE GROUND SURFACE WHERE THE JOINTS HAVE BEEN COVERED SHALL BE REPAIRED REGARDLESS OF THE TOTAL LEAKAGE SHOWN UNDER THE AFOREMENTIONED 150 POUND PRESSURE TEST. ALL PIPES, VALVES, FITTINGS AND APPURTENANCES FOUND TO BE DEFECTIVE UNDER TEST, SHALL BE REMOVED AND REPLACED AT THE CONTRACTOR'S EXPENSE. MAINS WHICH FAIL TO RECEIVE THE ENGINEER'S APPROVAL IN THE INITIAL TEST, SHALL BE REPAIRED AND RETESTED UNTIL THEIR CONSTRUCTION, WITH THE REQUIREMENTS OF THESE SPECIFICATIONS AND THE USUAL REQUIREMENTS OF THE MUNICIPAL CORPORATION RELATING TO WATER DISTRIBUTION IMPROVEMENTS. THE CONTRACTOR SHALL FURNISH THE ENGINEER A WRITTEN STATEMENT BY SAID MUNICIPAL CORPORATION APPROVING THE COMPLETED WATER DISTRIBUTION IMPROVEMENT AS A PREREQUISITE TO ASKING THE ENGINEER FOR APPROVAL OF A FINAL ESTIMATE.

3.4 DISINFECTION REQUIREMENTS

a. FOLLOWING WATERMAIN PRESSURE TESTING, DISINFECTION OF WATERMAINS IS TO BE ACCOMPLISHED. THE NEW WATERMAIN SHALL BE DISINFECTED USING THE FOLLOWING METHOD:
   i. CONTINUOUS FEED DISINFECTION: THIS METHOD SHALL USE EITHER PURE LIQUID CHLORINE OR A WATER CHLORINE SOLUTION OR CHLORINE GAS SUCH THAT THE CHORINE CONCENTRATION IN THE MAIN IS A MINIMUM OF 50 MG/1 AVAILABLE CHLORINE. SOLUTIONS OF ONE PERCENT CHLORINE SHALL BE PREPARED WITH SODIUM HYPOCHLORITE OR CALCIUM HYPOCHLORITE. THE LATTER SOLUTION REQUIRES APPROXIMATELY ONE POUND OF CALCIUM HYPOCHLORITE IN 8.5 GAL. OF WATER. THE FOLLOWING TABLE GIVES THE AMOUNT OF CHLORINE RESIDUAL FOR EACH 100 FEET OF PIPE OF VARIOUS DIAMETERS.

| | | | |
|---|---|---|---|
| 1. | 4 INCH PIPE | 0.027 LB. | 100% C12 0.33 GAL. 1% C12 SOLUTIONS |
| 2. | 6 INCH PIPE | 0.061 LB. | 100% C12 0.73 GAL. 1% C12 SOLUTIONS |
| 3. | 8 INCH PIPE | 0.108 LB. | 100% C12 1.30 GALS 1% C12 SOLUTIONS |
| 4. | 10 INCH PIPE | 0.170 LB. | 100% C12 2.04 GAL. 1% C12 SOLUTIONS |
| 5. | 12 INCH PIPE | 0.240 LB. | 100% C12 2.88 GAL. 1% C12 SOLUTIONS |

b. WATER FROM THE EXISTING DISTRIBUTION SYSTEM SHALL BE MADE TO FLOW AT A CONSTANT RATE INTO THE NEW PIPE LINE. THE CHLORINE SHALL BE APPLIED TO THE WATERMAIN WITH A CHEMICAL FEED PUMP DESIGNED FOR FEEDING CHLORINE.

c. DURING THE APPLICATION OF THE CHLORINE, VALVES SHALL BE MANIPULATED TO PREVENT THE TREATMENT DOSAGE FROM FLOWING BACK INTO THE LINE SUPPLYING THE WATER. CHLORINE APPLICATION SHALL NOT CEASE UNTIL THE ENTIRE MAIN IS FILLED WITH THE CHLORINE SOLUTION. THE CHLORINATED WATER SHALL BE RETAINED IN THE MAIN FOR AT LEAST 24 HOURS, DURING WHICH TIME ALL VALVES AND HYDRANTS IN THE SECTION TREATED SHALL BE OPERATED IN ORDER TO DISINFECT THE APPURTENANCES. AT THE END OF THIS 24 HOUR PERIOD, THE TREATED WATER SHALL CONTAIN NO LESS THAN 25 MG/1 CHLORINE THROUGHOUT THE LENGTH OF THE MAIN.

d. FOLLOWING CHLORINATION, ALL TREATED WATER SHALL BE THOROUGHLY FLUSHED FROM THE NEW PIPE LINES UNTIL THE REPLACEMENT WATER HAS A CHLORINE CONCENTRATION NO HIGHER THAN THAT GENERALLY PREVAILING IN THE EXISTING SYSTEM. AFTER FINAL FLUSHING, A SAMPLE SHALL BE TAKEN BY THE CITY FOR TESTING AND ANALYSIS FROM A STERILE METAL PIPE CONNECTION WITH SAMPLING COCK ATTACHED TO THE 1 INCH CORPORATION COCKS IN THE NEW LINE. A SECOND SAMPLE SHALL BE TAKEN 24 HOURS AFTER THE FIRST SAMPLE WITHOUT RE-FLUSHING THE LINE. QUALITY OF WATER SHALL MEET THE REQUIREMENTS OF THE DEPARTMENT OF PUBLIC HEALTH OF THE STATE OF ILLINOIS FOR DRINKING WATER FOR AT LEAST TWO CONSECUTIVE DAYS BEFORE PLACING THE NEW PIPE LINE OR SECTION IN SERVICE. SAMPLES TAKEN BY AN APPROVED TESTING COMPANY SHALL BE PRESENTED TO A LICENSED ILLINOIS ENVIRONMENTAL PROTECTION AGENCY LABORATORY FOR ANALYSIS. TYPE WRITTEN RESULTS SHALL BE FORWARDED TO THE CITY OF LAKE FOREST ENGINEERING SECTION FOR APPROVAL. THE FIRST SAMPLE SHALL BE TAKEN NO LATER THAN A WEDNESDAY.
e. SHOULD THE INITIAL CHLORINATING TREATMENT FAIL TO RESULT IN APPROVED LABORATORY ANALYSIS OF THE SAMPLED WATER, THE CHLORINATION SHALL BE REPEATED UNTIL APPROVED QUALITY OF WATER IS OBTAINED FROM THE NEW PIPE LINE EXTENSIONS OR SECTIONS.
f. CHLORINATING, FLUSHING, AND PRESSURE TESTING AND TAPPING ACTIVITIES SHALL ONLY BE PERFORMED DURING NORMAL WORKING HOURS.

**END OF SECTION**

## CATCH BASINS TO BE ADJUSTED WITH NEW TYPE 1 FRAME, OPEN LID

This work shall be done in accordance with Section 602 of the Standard Specification except as modified herein:

Add to section 602.11, new sub heading (d) to read as follows:

Salvaging and Reinstallation of Existing Frame and Grate. The existing frame and grate shall be removed and salvaged in a secure location during the period where the New Type 1 Frame, Open Lid is in place and temporary pavement has been placed. After the temporary pavement has been removed, the salvaged frame and grate shall be reinstalled on the existing catch basin and adjusted to grade if necessary. Note: Temporary Pavement placement and removal is paid for separately.

**REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES (PROJECT SPECIFIC)**

**Description.** This work shall consist of the removal and disposal of regulated substances according to Section 669 of the Standard Specifications as revised below.

**Contract Specific Sites.** The excavated soil and groundwater within the areas listed below shall be managed as either "uncontaminated soil", hazardous waste, special waste or non-special waste. For stationing, the lateral distance is measured from centerline and the farthest distance is the offset distance or construction limit, whichever is less.

Site 2686V2-2: Residences and Vacant Lots, 700-720 W. Deerpath Road, 700 block of W. Deerpath Road, 300 block of N. Deerpath Square, 380 N. Deerpath Square, 380-385 Chiltern Drive, 670-673 W. Edgecote Lane, 661-717 W. Kennington Terrace, and 257-315 N Mellody Road, Lake Forest, Lake County

- Station 44+20 to Station 46+15 (CL Deerpath Road), 0 to 35 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 44+20 to Station 45+30 (CL Deerpath Road), 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 46+30 to Station 48+30 (CL Deerpath Road), 0 to 55 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.

Site 2686V2-3: Faith Lutheran Church and Rectory, 680-688 W. Deerpath Road, Lake Forest, Lake County

- Station 48+05 to Station 48+95 (CL Deerpath Road), 0 to 55 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.

Site 2686V2-4: ROW, US 41 and W. Deerpath Road interchange, Lake Forest, Lake County

- Station 48+30 to Station 49+20 (CL Deerpath Road), 0 to 55 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 148+15 to Station 149+20 (CL US 41), 0 to 65 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.

Site 2686V2-6: UP Railroad Tracks, 600 block of W. Deerpath Road, Lake Forest, Lake County

- Station 50+70 to Station 51+75 (CL Deerpath Road), 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 51+00 to Station 52+20 (CL Deerpath Road), 0 to 35 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.

- Station 452+20 to Station 452+95 (CL US 41 NB Entrance Ramp), 0 to 45 feet LT, and 0 to 75 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 153+65 to Station 154+65 (CL Proposed Storm Sewer), 0 to 20 feet LT, and 0 to 20 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(1). Contaminant of concern sampling parameter: Manganese.

Site 2686V2-7: Skokie Valley Trail and Utility Easement, 600 block of W. Deerpath Road, Lake Forest, Lake County

- Station 51+75 to Station 52+95 (CL Deerpath Road), 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 53+65 to Station 54+15 (CL Deerpath Road), 45 to 85 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(5). Contaminants of concern sampling parameters: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Carbazole, Dibenzo(a,h)anthracene, and Indeno(1,2,3-cd)pyrene.
- Station 54+15 to Station 54+85 (CL Deerpath Road), 40 to 85 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(1). Contaminant of concern sampling parameter: Manganese.
- Station 54+15 to Station 54+70 (CL Deerpath Road), 85 to 160 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(5). Contaminants of concern sampling parameters: Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, and Manganese.
- Station 54+90 to Station 55+75 (CL Deerpath Road), 0 to 70 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(5). Contaminants of concern sampling parameters: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, and Indeno(1,2,3-cd)pyrene.
- Station 54+70 to Station 54+90 (CL Deerpath Road), 85 to 140 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 54+90 to Station 55+75 (CL Deerpath Road), 70 to 140 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.

Site 2686V2-9: Residences, 291-535 W. Deerpath Road, 365 Ahwahnee Lane, and 386 Ahwahnee Road, Lake Forest, Lake County

- Station 64+80 to Station 65+80 (CL Deerpath Road), 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 66+80 to Station 69+40 (CL Deerpath Road), 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.

Site 2686V2-10: Deerpath Golf Course, 500 W. Deerpath Road, Lake Forest, Lake County

- Station 55+45 to Station 56+95 (CL Deerpath Road), 0 to 35 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 63+25 to Station 64+50 (CL Deerpath Road), 0 to 35 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(5). Contaminants of concern sampling parameters: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Carbazole, Dibenzo(a,h)anthracene and Indeno(1,2,3-cd)pyrene.
- Station 64+50 to Station 65+75 (CL Deerpath Road), 0 to 75 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 65+75 to Station 66+85 (CL Deerpath Road), 0 to 75 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(3). Contaminants of concern sampling parameters: Benzo(a)pyrene and Manganese.
- Station 54+15 to Station 56+75 (CL Deerpath Road), 115 to 220 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 203+05 to Station 204+15 (CL Proposed Storm Sewer), 0 to 20 feet LT, and 0 to 20 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(3). Contaminants of concern sampling parameters: Benzo(a)pyrene and Manganese.
- Station 204+15 to Station 206+45 (CL Proposed Storm Sewer), 0 to 20 feet LT, and 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 206+45 to Station 207+45 (CL Proposed Storm Sewer), 0 to 20 feet LT, and 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(5). Contaminants of concern sampling parameters: Lead and Manganese.
- Station 207+45 to Station 209+45 (CL Proposed Storm Sewer), 0 to 20 feet LT, and 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 209+45 to Station 210+45 (CL Proposed Storm Sewer), 0 to 20 feet LT, and 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(1). Contaminant of concern sampling parameter: Manganese.
- Station 210+45 to Station 211+40 (CL Proposed Storm Sewer), 0 to 20 feet LT, and 0 to 35 feet RT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 65+75 to Station 69+85 (CL Deerpath Road), 150 to 455 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminants of concern sampling parameters: Arsenic and Manganese.

- Station 67+50 to Station 68+45 (CL Deerpath Road), 75 to 150 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.
- Station 66+85 to Station 69+85 (CL Deerpath Road), 0 to 75 feet LT. The engineer has determined that this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(2). Contaminant of concern sampling parameter: Manganese.

**Work Zones**
Three distinct OSHA HAZWOPER work zones (exclusion, decontamination, and support) shall apply to projects adjacent to or within sites with documented leaking underground storage tank (LUST) incidents, or sites under management in accordance with the requirements of the Site Remediation Program (SRP), Resource Conservation and Recovery Act (RCRA), or Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or as deemed necessary. For this project, the work zones apply for the following ISGS PESA Sites: None.

Additional information on the above sites collected during the Phase I Engineering process is available through the District's Environmental Studies Unit (DESU).

## TEMPORARY PORTABLE BRIDGE TRAFFIC SIGNALS

Add the following to CHECK SHEET #19 of the Standard Recurring Special Provision for Road and Bridge Construction.

The City of Lake Forest requires that the temporary portable bridge traffic signals shall be equipped with an emergency vehicle priority system to alter the normal signal timing and phasing plan during the approach and passage of emergency vehicles.

The emergency signal preemption system shall interrupt the normal sequence of operation to either extend a currently displayed green interval or change the signal to display a green indication ahead of fire vehicles, law enforcement vehicles, ambulances, and other official emergency vehicles for the requesting direction. During the transition into and transition out of preemption control, the yellow change interval, and any red clearance interval that follows, shall not be shortened or omitted. The return to the previous green signal indication shall be permitted following a steady yellow signal indication in the same signal face, omitting the red clearance interval.

It shall be the Contractor's responsibility to contact the City of Lake Forest, prior to bidding, to ensure the equipment is completely compatible with all components of the equipment currently in use by the City of Lake Forest and other local emergency service providers in the area.

A confirmation beacon shall be provided for each approach. All light operated systems shall include security and transit preemption software and operate at a uniform rate of 14.035 Hz ±0.002, or as otherwise required by the Engineer, and provide compatible operation with other light systems currently being operated in the City of Lake Forest.

All labor and material required to install and maintain the Emergency Vehicle Preemption System shall be considered included at the contract unit price for each system installed in the pay item for TEMPORARY BRIDGE TRAFFIC SIGNALS.

**ELECTRIC SERVICE INSTALLATION**

Description: The item shall be installed in accordance with Section 804 of the Standard Specifications except as follows:

Art. 804.4, first paragraph shall read:
Installation. The electric service installation shall extend beyond utility owned facilities to the point of cable termination of the incoming power to the pump station building. It shall be installed according to the phasing, ampere rating, and voltage shown on the plans.

Art. 804.4, third paragraph, last sentence shall read:
The metering and service disconnect shall be installed on the exterior of the pump station building.

Art. 804.4, fourth paragraph shall read:
The total length of underground service between the pump station and primary transformer shall not exceed 250 ft (76m). The above ground service pedestal location will be established by the Engineer.

Art. 804.4, last paragraph shall read:
Underground cable coming up the wood pole from the utility transformer and back down the pole to the pump station building shall be protected in conduit protected by galvanized steel “U” guard. The “U” guard shall be attached to the pole with 3/8 x 3 in. galvanized steel lag bolts.

**HOT-MIX ASPHALT DRIVEWAY PAVEMENT**

Description. This work shall consist of furnishing, placing and compacting hot-mix asphalt driveway pavement at locations shown on the plans and as directed by the Engineer.

This work shall conform to the applicable Sections of Articles 355 and 406 of the Standard Specifications and District Detail BD-02.

Commercial driveways shall be constructed to a nominal thickness of 10 inches, which shall consist of a minimum 2 inch thick surface course (HMA Surface Course, Mix "D", N50) with the balance constructed using hot mix asphalt binder course (HMA Base Course, 8"). Aggregate and bituminous material prime coats shall be applied according to Article 406 and as directed by the Engineer. Subase Granular Material, Type B 4" shall be installed prior to placement of the Hot-Mix Asphalt Driveway Pavement.

Method of Measurement. Hot-Mix Asphalt driveway pavement will be measured in place and the area computed in square yards. The pavement materials and aggregate and bituminous material prime coats will not be measured for payment separately but shall be considered included in payment for Hot-Mix Asphalt Driveway Pavement. Subase Granular Material, Type B 4" shall be paid for separately.

Basis of Payment. The work will be paid at the contract unit price per square yard for HOT-MIX ASPHALT DRIVEWAY PAVEMENT, 8" or HOT-MIX ASPHALT DRIVEWAY PAVEMENT, 10", which price shall be full payment for all materials, labor, and equipment necessary to constructon of the driveways or parking lot.

**WELDED WIRE FABRIC 6X6**

Description. This work shall consist of furnishing and placing welded wire reinforcement of the spacing and size shown on the plans. Welded wire reinforcement shall be epoxy coated where specified on the plans.

Materials. Materials shall be according to Article 1006.10 of the Standard Specifications.

Method of Measurement. This work will be measured for payment in place and the area computed in square yards.

Basis of Payment. This work will be paid for at the contract unit price per square yard for WELDED WIRE FABRIC 6X6.

**CLEANING DRAINAGE SYSTEM**

Description. This work consists of cleaning the existing drainage scuppers on the US 41 at Deerpath Road bridge.

Construction Requirements. The Contractor shall clean the existing scuppers on this bridge. This will include cleaning the bridge scupper as well as the downspout portion of the scupper for every scupper located on the bridge. The method shall not damage the existing drainage system and shall be submitted to the Engineer for approval. Any damage to the drainage system shall be repaired by the Contractor at no additional cost to the Department.

Basis of Payment. This work will be paid for at the contract lump sum price for CLEANING DRAINAGE SYSTEM.

**DRAINAGE SYSTEM**

Description. This work shall consist of furnishing and installing a bridge drainage system that connects to an existing drainage system as shown on the plans, including all piping, fittings, support brackets, inserts, bolts, and connections to existing structures.

The existing piping typically consists of cast iron, steel, fiberglass or PVC pipe with diameters from 6 to 12 inches. The Contractor and Engineer shall inspect and field verify the locations, pipe sizes and dimensions of existing drainage system that the proposed drainage system connects to prior to commencing the work.

Material. The pipe and fittings shall be reinforced fiberglass according to ASTM D 2996 RTRP with a 30,000 psi (207 MPa) minimum short-time rupture strength hoop tensile stress. The reinforced fiberglass shall also have an apparent stiffness factor at 5 percent deflection exceeding 200 cu in.-lbf/sq. in. (22.6 cu mm-kPa) and a minimum wall thickness of 0.10 in. (2.54 mm). The adhesive for joining pipe and fittings shall be as recommended by the manufacturer. All pipe supports and associated hardware shall be hot dip galvanized according to AASHTO M 232 (M 232M). The fiberglass pipe and fittings furnished shall be pigmented through out, or have a resin-rich pigmented exterior coat, specifically designed for overcoating fiberglass, as recommended by the manufacturer. The color shall be as specified by the Engineer. The resin in either case shall have an ultraviolet absorber designed to prevent ultraviolet degradation. The ultraviolet protection shall be designed to withstand a minimum of 2,500 hours of accelerated weathering when tested in conformance with the requirements in ASTM Designation: G 154. Lamps shall be UV-8 (313 nm wavelength). The resting cycle shall be 4 hours of ultraviolet exposure at 140°F (60°C), and then 4 hours of condensate exposure at 120°F (49°C). After testing, the surface of the pipe shall exhibit no fiber exposure, crazing, or checking, and only a slight chalking or color change. The supplier shall certify the material supplied meets or exceeds these requirements.

Design. The drainage system shall be designed as an open system with allowances for the differential expansion and contraction expected between the superstructure and the substructure to which the drainage system is attached.

Installation. All connections of pipes and fittings shown on the plans to facilitate future removal for maintenance cleanout or flushing shall be made with a threaded, gasketed coupler or a bolted gasketed flange system. Adhesive bonded joints will be permitted for runs of pipe between such connections. The end run connection shall feature a minimum nominal 8 in. (150 mm) female threaded fiberglass outlet. Straight runs may utilize a 45 degree reducing saddle bonded to the pipe. The female outlet shall be filled with a male threaded PVC plug.

Runs of pipe shall be supported at spacings not exceeding those recommended by the manufacturer of the pipe. Supports that have point contact or narrow supporting areas shall be avoided. Standard slings, clamps, clevis hangers and shoe supports designed for use with steel pipe may be used. A minimum strap width for hangers shall be 1 1/2 in. (40 mm) for all pipe under 12 in. (300 mm) in diameter and 2 in. (50 mm) for diameters 12 in. (300 mm) or greater. Straps shall have 120 degrees of contact with the pipe. Pipes supported on less than 120 degrees of contact shall have a split fiberglass pipe protective sleeve bonded in place with adhesive.

All reinforced fiberglass pipe, fittings, and expansion joints shall be handled and installed according to guidelines and procedures recommended by the manufacturer or supplier of the material.

Additional Requirements. Certain locations of connections to existing structure may require the removal of bituminous or concrete materials and excavation to remove damaged sections of pipes and make proper new connections. This work shall be as directed by the Engineer for each individual location that this applies. The work involved will also include backfilling and restoration of the surfaces with approved materials and at the direction of the Engineer.

The Contractor, at the direction of the Engineer, may be required to install expansion joints at locations of pipe repairs where free movement is required to prevent future deterioration. Cost of furnishing and installing the expansion joint is included with this item.

Cost of material, material removal, excavation, and restoration associated to making connection to the existing drainage system will not be paid for separately.

Cost of downspout removal, labor and material associated to ensealing existing structure connection hole will not be paid for separately.

Basis of Payment. This work will be paid for at the contract lump sum price for DRAINAGE SYSTEM.

**DRILL AND GROUT DOWEL BARS**

Description. This work shall consist of drilling and grouting dowel bars into the existing concrete base course in the areas of widening or curb and gutter replacement adjacent to an existing composite pavement section.

This work shall be done in accordance with the applicable portions of Section 442 of the Standard Specification except as modified herein:

Replace the first paragraph of Article 442.06 (a) (2) to read as follows:

"(2) Class B Patching. Dowel bar holes shall be drilled as shown on the plans."

Remove everything from the 6th paragraph and below from Article 442.06 (a) (2) beginning with the sentence "Patches of more than 20 ft (6m)…"

This work will be paid for at the contract unit price each for DRILL AND GROUT DOWEL BARS.

**ROCK FILL**

Description. This work shall consist of the furnishing and placement of rock fill where unstable and/or unsuitable materials have been removed below the plan bedding grade of proposed retaining walls. This work shall be done as shown on the plans and as directed by the Engineer.

Materials. Materials shall meet the following requirements of the Standard Specifications:

| Item | Article/Section |
|---|---|
| (a) Coarse Aggregate | 1004 |
| (b) Rock fill | 1005 |

For Rock Fill depths ≤24", the material shall meet Quality Designation "B" as required in Article 1004.01 of the Standard Specifications for Road and Bridge Construction. The material shall be crushed stone and meet the gradation of CA 1, CA 6 or CA 7 per Article 1004.01 of the Standard Specifications for Road and Bridge Construction.

The aggregate shall be placed in 6 in. lifts, loose measurements, and compacted in a manner approved by the Engineer, except that if the desired results are being obtained, the compacted thickness of any lift may be increased to a maximum of 8 inches.

For Rock Fill depths > 24", the top 6" shall meet the requirements listed above for depths ≤24" and the remaining depth shall meet Quality Designation "B" as required in Article 1005.01 of the Standard Specifications for Road and Bridge Construction and may be shot rock or primary crusher run. It shall not contain objectionable quantities of dirt, sand, clay or rock fines. The material shall be well graded with a maximum stone dimension of 8 inches. No more than 35% shall have a dimension less than 2 inches.

Construction Requirements. Rock fill shall be placed following the excavation of unstable and/or unsuitable material. The rock fill shall be seated to the satisfaction of the Engineer. The top surface of the rock fill shall consist of 6 inches of aggregate gradations CA 6 or CA 7.

Method of Measurement. Rock fill will be measured for payment in place and the volume computed in cubic yards. The width and depth for measurement will be as shown on the plans, or as directed by the Engineer.

Basis of Payment. Rock fill will be paid for at the contract unit price per cubic yard for ROCK FILL.

Removal and disposal of unstable and unsuitable materials will be paid for according to Section 502 of the Standard Specifications.

**MAINTENANCE OF EXISTING PUMP STATION**

Description. This work consists of maintaining of the operation of the existing Pump Station 38.

General Requirements. It is the intent of the Contract Drawings and referenced Standard Specifications, to define the work required for the maintenance and operation of the existing Pump Station 38 facility during construction. No portion of the work required to provide a coordinated complete installation shall be omitted even though not expressly specified or indicated.

Maintenance Requirements. Existing Pump Station Maintenance During Construction

From the first day the Contractor begins work at the site until the day of final acceptance of the new pump station by the Engineer, the Contractor shall be fully responsible for maintenance of the existing Pump Station 38. Maintenance shall be in full compliance with the District 1 Electrical Maintenance Contract, September 2015 or the most recent contract from the date of BID.

The Contractor shall transfer the maintenance of Pump Station 38 to the Department at the day of final acceptance of the new pump station by the Engineer and IDOT Maintenance. The Contractor shall be responsible for maintaining the new equipment installed in the Pump Station in accordance with the equipment manufacturer's written instructions and maintenance recommendations. The Contractor shall be responsible for maintaining the existing Pump Station including but not limited to, removal of silt and debris from wet well until maintenance has been transferred to the Department. Contractor shall clean wet well at intervals not to exceed three months. The wet well shall be cleaned and free of debris prior to filling with lightweight cellular concrete fill.

Prior to the starting of work, the Contractor shall notify the Engineer and arrange for a pre-construction inspection. At the pre-construction inspection, the facility and its equipment shall be examined and defective or missing items shall be repaired by the State's Electrical Maintenance Contractor or shall otherwise be noted. A record of inspection shall be furnished to the Engineer.

Emergency Service Requirements.
The Contractor shall be responsible for providing 24-hour, 7 days a week emergency response to existing pumping station alarms. Upon notification of a pump station alarm, the Contractor shall dispatch emergency service personnel to the station immediately and shall arrive at the station within one (1) hour of the receipt of the alarm. All necessary emergency repairs required to restore the pump station to its normal operating condition shall be done by the Contractor immediately. Emergency service personnel shall remain at the station to monitor the situation until the alarm(s) are cleared or otherwise notified by the IDOT engineer.

(a) The IDOT COMCENTER shall be immediately notified by the Contractor whenever an "Entry Alarm" or "Water on Pavement Alarm" are received, the IDOT COMCENTER shall be notified with the following information: number of pumps running, water depth in wet well, depth of water on pavement and if the drainage inlets are clogged.
(b) Failure to respond or meet the emergency service requirements of a pumping station alarm, the Contractor shall be liable to the Department in the amount paid to other subcontractors hired by the State to perform the necessary alarm response.

Routine Maintenance Requirements. Ongoing maintenance activities are required to maintain the existing Pump Station 38 for proper roadway drainage. Routine maintenance inspections of all equipment shall be conducted by the Contractor. Routine maintenance items shall be done at intervals and as outlined in the District 1 Electrical Maintenance Contract, Article 15.0 "Routine Patrol Requirements".

Failure to meet the routine maintenance requirements of the pumping station, the Contractor shall be liable to the Department in the amount paid to other subcontractors hired by the State to perform the necessary routine maintenance.

All surrounding landscaping of the existing Pump Station 38 shall be maintained by the Contractor during construction. All grass areas shall be mowed and maintained at a maximum two (2) inch height. Snow plowing of the facility shall be provided no more than two working days after a snow fall of one (1) inch or more.

Temporary Bulkhead. A water tight, temporary bulkhead shall be installed in Proposed Manhole 39 on the east (downstream) opening durning the installation of the manhole. The temporary bulkhead shall be approved by the engineer, prior to installation and shall be able to be removed without damging the manhole structure. This bulkhead will prevent water from flowing east to the pump station during construction, and allow water to backflow into the existing pump station to maintain existing drainage. The Engineer will determine when this bulkhead shall be removed, which will correspond with when the new pump station is online and the old pump station is decommissioned.

Method of Measurement and Payment. This work shall be measured and paid for at the Contract lump sum price for MAINTENANCE OF EXISTING PUMP STATION DURING CONSTRUCTION, which shall be payment in full for the work described herein.

**RETAINING WALL REMOVAL**

Description. This work shall consist of all material, labor and equipment required for the removal, salvaging, and reinstallation of two existing flagstone retaining walls in the same locations. Existing flagstone retaining walls are located on Deerpath Road between stations 51+50 and 51+95 on both the north and south sides of the road at the back of sidewalk. An aggregate stone infiltration trench will be constructed behind the existing retaining walls which may require part or all of the existing retaining walls to be removed and replaced during construction. The replaced retaining wall shall reuse the salvaged flagstones and be placed in the same location and height as the existing wall. The wall shall be reconstructed in the same fashion as the existing wall and shall provide earth retention for the infiltration trench.

General. This item shall consist of removing, salvaging, and reinstalling flagstone retaining wall systems at the locations shown in the plans. The retaining wall flagstones shall be removed without damaging the materials shall be salvaged and stored on site. The Engineer shall coordinate the storage location with the City of Lake Forest. All equipment, tools, labor, and any new materials needed to reconstruct the retaining wall including but not limited to any geofabric, geogrid, grout, mortar, or adhesives shall be included in the cost of this work. The reconstructed retaining walls shall be approved by the Engineer and the City of Lake Forest.

Method of Measurement. The removal, salvaging and reconstructing of the existing retaining walls shall be measured for payment in square feet for the area of the wall removed.

Basis of Payment. This item shall be paid for at the contract unit price per square foot for RETAINING WALL REMOVAL and include all labor, equipment, tools, salvaging costs, and new materials required to remove, salvage and reconstruct the retaining walls.

**STORM SEWER TO BE FILLED**

Description. The work shall consist of filling abandoned storm sewers at the locations shown on the plans and as directed by the engineer. All storm sewer pipes to be abandoned in place shall be completely filled with Controlled Low Strength Material (CLSM), per section 1019 of the standard specification. The ends of the storm sewer pipe shall be sealed with cement bricks and mortar, a poured concrete plug, or other means approved by the Engineer.

Method of Measurement. This work will be measured for payment in place and the volume computed in cubic yards.

Basis of Payment. This work will be paid for at the contract unit price per cubic yard for STORM SEWER TO BE FILLED. This price shall include all costs for providing and injecting CLSM, capping and all other labor, equipment, and materials necessary to abandon and fill the pipe in accordance with the Specifications including sealing the ends of the storm sewer.

**TELEVISION INSPECTION OF SEWER**

Description. This work consists of providing all labor, equipment, and material necessary to televise existing storm sewers, existing culverts, or existing field tile to remain or to be filled at the locations shown on the plans and other locations as approved and as directed by the Engineer. Existing storm sewer and culverts shall be cleaned prior to televising.

Requirements: The Contractor shall provide two (2) copies each of a narrated videotape using DVD format and a written video inspection report to the Engineer.

If any deficiencies are found, the Contractor shall either repair or replace the existing storm sewer, existing culvert, and existing field tile as directed by the Engineer. The cost of the repairs or replacement for the existing field tile shall be paid for using pay items included in the contract or in accordance with Article 109.04 of the Standard Specifications.

After the Contractor has completed any repairs or replacements, the Contractor shall re-televise the storm sewer, culvert or field tile as directed by the Engineer. The Contractor shall provide two (2) copies each of a narrated videotape using DVD format and a written video inspection report of the re-inspection. The cost of video inspection of the storm sewers, culverts, or field tile after any repairs or replacements will not be paid for separately and shall be included in the contract unit price for television inspection of sewer.

Method of Measurement. This work will be measured for payment in sewer televising per foot based on the length of the video inspection.

Basis of Payment. This work will be paid for at the contract unit price per foot for TELEVISION INSPECTION OF SEWER regardless of sewer diameter.

Storm sewers and culverts to be cleaned shall be paid for separately.

**PLUG EXISTING STORM SEWERS**

This work will consist of plugging existing storm sewers noted and located on the plans, as specified herein, and as directed by the Engineer.

The ends of the storm sewers will be excavated, if necessary, to the bottom flowline and to a minimum of 18” inside the barrel of the storm sewer. The inside of the storm sewer at the excavated end shall be cleaned of all earth and debris to the satisfaction of the Engineer.

The Contractor shall construct / install a suitable permanent or temporary bulkhead at the opening of the storm sewer consisting of an inflatable type plug capable of containing the proposed Controlled Low-Strength Material (CLSM) in accordance to Section 593 of the Standard Specifications.

The cost of cleaning the storm sewer end and constructing suitable permanent or temporary bulkheads and filling with CLSM will be paid for at the contract unit price per cubic yard for PLUG EXISTING STORM SEWERS.

**ELASTOMERIC CHECK VALVE**

Description. This work shall consist of the furnishing and installation of an Elastomeric Check Valve of the diameter specified, installed within a manhole structure at the location shown on the plans.

Manufacturers. Elastomeric Check Valve of the diameter specified shall be manufactured by one of the following companies:

a) Red Valve/Tideflex Technologies
b) Cla-Val
c) Onyx Valve
d) Proco Products, Inc.

Note: Contractor shall coordinate the procurement of the elastomeric check valve with the manufacturer prior to purchasing. Manufacturers shall recommend a model specification based on the requirements in the field. Any required information the manufacturer needs regarding the hydraulics of the system shall be supplied by the Engineer

Construction Requirements. This work shall be performed according to the manufacturer's recommended installation method.

Basis of Payment. This work will be paid for at the contract unit price per each for ELASTOMERIC CHECK VALVE of the diameter specified, which shall include all materials, equipment, and labor for completing the work.

**GAS UTILITY SERVICE CONNECTION**

Description. This work shall consist of the following: 1) Connecting the natural gas service (utility meter) to the emergency generator at Pump Station 38 and 2) Coordinating the installation and cost of establishing the gas service connection and gas meter from the gas main with the Gas Utility Company.

The Contractor shall furnish and install necessary piping, connectors and fittings to connect the new generator system to the natural gas service (utility meter). All piping, fittings, and installation shall be in accordance with Section 23 11 23 of the Specifications.

The Contractor shall coordinate the installation of the gas service connection from the public right of way to the gas meter location including installation of the gas meter, with the gas utility company. This work includes, but is not limited to filing the application for service, coordinating dates and times when the service will be installed, providing the utility company access to the site for service installation, coordination with the utility company on gas meter location, and all costs and fees, associated with the service installation including monthly bills until the time when the service is transferred to the Owner.

Basis of Payment. This work will be paid for at the contract lump sum price for GAS UTILITY SERVICE CONNECTION.

**DRIVEWAY REMOVAL AND REPLACEMENT**

Description. This item includes the complete removal of existing brick pavers and existing bedding material at locations shown, storing of the brick pavers, and the reinstallation of the brick pavers after temporary pavement has been removed at the location shown on the plans or as designated by the Engineer. Brick Paver removal shall be completed in accordance applicable portions of Section 220 and Section 440 of the Standard Specifications. Any tree roots within the aggregate base shall be removed prior to installation of any temporary pavement and shall be included in the unit price of this pay item.

After temporary pavement has been removed, the contractor shall reinstall the brick pavers at with the same pattern and construction as existing. All materials required for reinstallation including but not limited to, coarse aggregate, fine aggregate, and sand, will be included in this pay item.

Basis of Payment. DRIVEWAY REMOVAL AND REPLACEMENT will be paid for at the contract unit price per Square Yard for DRIVEWAY REMOVAL AND REPLACEMENT and will include all of the work described herein.

**DEWATERING**

Description. This work shall consist of providing labor, tools, equipment, and materials necessary for dewatering (regardless of the water source) the pump station building site to relatively dry conditions as determined by the Engineer and maintain suitable working conditions and sediment control so that the improvements are constructed in the dry.

Materials. The Contractor shall be solely responsible for the choice of products and equipment; for the design, installation, and operation; as well as "means and methods" of performing the work; and subsequent removal of dewatering systems and their safety and conformity with local codes, regulations and these Specifications. All products, equipment and "means and methods" selected shall be adequate for the intended use/application. Review by the Engineer does not relieve the Contractor from compliance with the requirements specified herein.

The Contractor shall submit to the Engineer for review a description of dewatering techniques and equipment to be used, together with detail drawings showing lengths of discharge piping and points of discharge including erosion control procedures.

Methods. The Contractor shall select the pumps he/she desires to use and the rate at which the pumps discharge. Adequate protection at the pump discharge shall be provided by the Contractor, subject to review by the Engineer. The Contractor shall ensure that downstream water quality shall not be impaired which includes but not limited to collection and disposal of sediment and floatables. Contractor shall position pumps/generators as far away from private residences as possible. The Contractor shall provide noise abatement as directed by the Engineer. Electric pumps are highly encouraged.

At all times during the excavation period and until completion and acceptance of work at Final Inspection, ample means and equipment shall be provided with which to remove promptly and dispose of properly all water (including ground water, storm sewer water, storm runoff and water generated from Contractor's activities) entering any excavation or any other parts of the work.

Water pumped or drained from the work required for this Contract shall be disposed of in a safe and suitable manner without damage to adjacent property or streets or to other work under construction. Water shall not be discharged without adequate protection of the surface at the point of discharge. All water from dewatering operations shall be filtered by using filter bags or another alternative measure approved by the Engineer. All filter bags must have secondary containment devices and should be placed on level ground. Water from dewatering operations must have sediment removed before being allowed to return to the original lake, creek, and/or ditch. The discharge shall be designed so that the returning waters do not cause erosion. No water shall be discharged into sanitary sewers. Any and all damages caused by dewatering the work shall be promptly repaired by the Contractor. The Contractor is responsible for providing any and all labor, materials and equipment needed for DEWATERING in order to meet the scheduled completion of the project.

Basis of Payment. This work shall be paid for at the contract unit price per lump sum for DEWATERING.

**TEMPORARY SUPPORT SYSTEM (TO REMAIN IN PLACE)**

Description. This item shall consist of furnishing all material, equipment and labor to fabricate, construct and erect the Temporary Support System as shown on the plans and according to Section 505 of the Standard Specifications.

Materials. Materials shall be according to the following Articles of the Standard Specifications:

| Item | Article/Section |
|---|---|
| (a) Structural Steel …… | 1006.04 |
| (b) High-Strength Steel Bolts | 1006.08(a) |
| (c) Anchor Bolts and Rods | 1006.09 |

Pier and sleeve sections shall conform to ASTM A500, Grade B.

Scope of Work:
This work consists of furnishing all labor, tools, equipment and materials associated with the preparation and installation of resistance piers according to the standard specifications and this special provision. The work includes, but is not limited to, the following:

Preparation of calculations and shop drawings signed and sealed by an Illinois Licensed Structural Engineer and submitted to the Engineer for review and approval;

Preparation of a construction procedure signed and sealed by an Illinois Licensed Structural Engineer and submitted to the Engineer for review and approval. The installation procedure shall include but not be limited to installation of the pier bracket, driving of pier sections, driving of pipe sleeves, and pipe grouting.

Installation of pier sections and associated connection hardware in accordance with approved shop drawings;

Documentation of the pier installation including driving forces at intervals recommended by the manufacturer, and final pier depth.

Construction Requirements. The Contractor shall install the resistance piers to the required capacity and in accordance with details in the plans to support the existing retaining wall footings. Signed and sealed shop drawings must be submitted for review and approval prior to beginning work. Structure Excavation below the footing shall not commence until the Temporary Support Systems and cast-in-place reinforced concrete beams are in place at the locations specified in the plans, and approval has been given by the Engineer to commence with installation of the Temporary Soil Retention System and excavation below the footings for the purpose of existing timber pile removal.

Resistance piers shall be installed in segments requiring couplings to be used between pier sections. The pier coupling shall be a 6" long tubular steel section of suitable diameter to fit inside the pier section. The coupling shall be inserted and attached 3" inside one end of each pier section that follows the initial pier section. The remaining 3" of the coupling extends beyond the pier section. The pier sections shall be installed vertically and any lateral bracing necessary in order to achieve a vertical installation shall be included with this item. All components shall conform to ASTM A513 or ASTM A500 Grade B. The coupling shall be attached by an embossed mechanical connection or by plug welding the coupling to the pier pipe.

All welding shall be done in the shop and in accordance with AASHTO/AWS D1.5 Bridge Welding Code.

Any additional fasteners, bracing, anchors, or timber blocking required in order to provide stability of the system during erection will not be measured for payment but shall be included in unit cost of TEMPORARY SUPPORT SYSTEM (TO REMAIN IN PLACE).

Upon completion of the construction, the Temporary Support System shall remain in place.

Driving and Testing for Pier Capacity. All pier sections shall be continuously driven by use of a hydraulic cylinder assembly and reaction frame. The initial pier section shall have a friction reduction collar on the bottom end. Additional pier sections shall be added as the pier driving operation continues. Driving of the pier sections will continue until rock or a suitable bearing stratum is reached as defined by a force equal to 1.65 times the working load specified by the engineer.

Method of Measurement. This work will be measured per each at the locations specified on the plans.

Basis of Payment. This work will be paid for at the contract unit price per each for TEMPORARY SUPPORT SYSTEM (TO REMAIN IN PLACE).

**TEMPORARY STORM SEWER**

Description. This work shall be performed in accordance with Section 550 of the Standard Specifications. Material used for the storm sewer shall be at the contractor's discretion and shall be approved by the engineer. Any damage to the temporary storm sewer incurred as a result of unrelated construction processes, traffic, weather, or other reasons shall be replaced at the contractor's expense. Removal of the temporary storm sewer and backfilling shall be included in this item.

Method of Measurement and Basis of Payment. This work shall be measured and paid for in accordance with Article 550.09 of the Standard Specifications for TEMPORARY STORM SEWER of the diameter specified, and shall include all materials, labor, and equipment to perform the work.

**EXPLORATION TRENCH, SPECIAL**

Description. This work shall consist of locating and excavating, by methods of hand excavation or vacuum excavation approved by the Engineer, to verify the horizontal and vertical location of existing regulated (e.g., electric, natural gas, telephone) unregulated (e.g., water, sewer, irrigation) utilities within the Contract Limits shown on the Plans and/or as directed by the Engineer.

Materials. The Materials used for Porous Granular Embankment and backfill shall consist of coarse aggregate meeting the gradation of CA-18 in accordance with Article 1004.05 of the Standard Specifications.

General Requirements. In non-emergency conditions and unless specified elsewhere, the Contractor shall contact the owner of the utility at least seventy-two (72) hours prior to exploratory digging, to provide the anticipated location and to be available during exploration activities. The depth and width of the exploration shall be sufficient to allow positive identification of the type, size and depth of the utility(s). The number of exploration trenches for utilities running along the roadway shall be as directed by the Engineer.

When an existing utility is encountered, the Contractor shall verify the type of facility, obtain the horizontal and vertical (to the top of conduit or pipe) data, and transmit a copy of this data to the Engineer. Located utilities shall be marked with lath, flags or any other suitable method which will provide positive identification throughout construction.

Any costs resulting from damage incurred to any utility (including interruption of service provided) shall be the sole responsibility of the Contractor.

After positive location, the Engineer will direct the Contractor as follows:

- Backfill and/or restore the excavated area.
- Leave the excavated area open and protected. The excavated material shall either be stockpiled in an acceptable location and provided with suitable erosion control measures, or disposed of off-site in accordance with Article 202.03 of the Standard Specifications.

Method of Measurement. Exploration trench will be measured for payment in feet based on the actual horizontal or vertical length along the utility line. Vertical length is measured from the ground down to the top of the utility.

Basis of Payment. This work will be paid for at the contract unit price per foot for EXPLORATION TRENCH, SPECIAL.

**INLET FILTER CLEANING**

This work shall be done in accordance with the applicable portions of Section 280 of the Standard Specification except as modified herein:

Add the following paragraph to Article 280.05:

> Inlet Filters shall be maintained as follows: Remove silt from fabric insert when the filter becomes clogged, performance is compromised, and/or excessive sediment accumulates. Accumulated sediment shall be removed regularly, but at a minimum when a device's capacity for sediment storage has been reduced by 50%.

Add the following sentence at the end of Article 280.08 (d):

> Regular maintenance of Inlet Filters will be paid for at the contract unit price per each for INLET FILTER CLEANING regardless of how often a device requires emptying.

**CURB REMOVAL AND REPLACEMENT**

Description.
This work shall consist of the complete removal and replacement of existing curb, gutter, and combination curb and gutter in accordance with Section 440 and Section 606 of the Standard Specification. The contractor shall replace existing curb and gutter sections as shown on the plans or as determined by the Engineer with vertical and horizontal geometry that matches the existing conditions of the section of curb, gutter, or combination curb and gutter which was removed or at new drainage structure locations as shown on the plan detail for "Special Frame And Grate Casting Detail".

Method of Measurement.
This work shall be measured for payment in feet along the flow line of the constructed curb, gutter, and combination curb and gutter. The removal and replacement will not be paid separately but shall be included together along the length described.

Basis of Payment.
The removal and replacement of existing curb, gutter, and combination curb and gutter will be paid for at the contract unit price per foot for CURB REMOVAL AND REPLACEMENT.

**HOT-MIX ASPHALT SURFACE REMOVAL, VARIABLE DEPTH**

Description. This work shall consist of removing the existing HMA surface in the areas shown on the plans. The work shall be completed in accordance with Section 440 of the Standard Specifications except as modified herein.

Removal Depth. The asphalt surface shall be removed to a depth of 3 inches below the edge of gutter in the area between the edge of gutters. Specific areas, identified below, have asphalt pavement of one to three inches in depth between the edge of gutter and the face of curb (over the existing gutter). Asphalt in these areas shall be removed to the surface of the gutter, leaving the existing curb and gutter intact. Any existing gutter damaged by the contractor shall be repaired or replaced as needed and approved by the engineer.

Areas of Asphalt Over Gutter. The following areas are known to have asphalt pavement over the existing gutter. Any areas not listed below having asphalt pavement over the existing gutter where the curb and gutter is not scheduled for removal, shall have the asphalt removed.

45+73 to 47+53 LT
51+78 to 53+10 LT
51+10 to 51+54 RT
53+29 to 54+70 LT
54+21 to 54+69 RT
54+78 to 55+16 LT
54+82 to 55+08 RT
55+43 to 55+69 LT

Contractor shall maintain positive drainage during and after asphalt surface removal.

Method of Measurement. This work will be measured for payment in square yards.

Basis of Payment. This work will be paid for at the contract unit price per square yards for HOT-MIX ASPHALT SURFACE REMOVAL, VARIABLE DEPTH.

**CLASS D PATCHES, TYPE IV, 12 INCH (SPECIAL)**

Description. This work shall consist of placing Class D Patches for storm sewer installation, utility relocation, and roadway maintenance at the locations shown in the plans and as directed by the Engineer. The work shall be performed in accordance with Section 442 of the Standard Specifications, except as modified herein.

Delete Table of Types from Article 442.01 of the Standard Specification.

Revise Note 2 from Article 442.02 of the Standard Specification to read:

> "Note 2. The mixture composition of the HMA used shall be binder course and surface course as specified in the Hot-Mix Asphalt Mixture Requirements Table."

Add the following to Article 442.05 (c) of the Standard Specifications:

"For Class D Patches, Type IV, 12 Inch (Special) the transverse limits of each patch shall be approved by the Engineer. The transverse edge shall be full-depth sawcut to form a clean, square edge with the pavement to remain. Damage to the pavement to remain made during the installation of the patch will be repaired to the satisfaction of the Engineer at the Contractor's expense."

"For Class D Patches, Type IV, 12 Inch (Special), the installed patch shall match existing pavement grade on the surface and at the base of the patch. If the existing pavement section does not match the patch depth specified, the patch shall be adjusted to match the existing pavement section depth. No extra payment shall be made for additional materials due to pavement depth discrepancies.

Add the following to Article 442.10 of the Standard Specifications:

"Class D Patches, Type IV, 12 Inch (Special) shall be measured for payment in place, and the area computed in square yards."

Add the following to Article 442.11 of the Standard Specifications:

"This work shall be paid for at the contract unit price per square yard for as CLASS D PATCHES, TYPE IV, 12 INCH (SPECIAL), which price shall include all labor, materials and equipment necessary to perform the work. Full-depth sawcuts will not be measured for payment and will be included in the cost for this item.

**STORM SEWERS TO BE CLEANED**

Description. This work consists of cleaning existing storm sewers at the locations shown on the plans.

Construction Requirements. The Contractor shall clean the storm sewers of all silt, debris and/or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection. The method of cleaning shall not damage the existing storm sewers and shall be submitted to the Engineer for approval. Any damage to the existing storm sewers shall be repaired by the Contractor at no additional cost to the Department.

The upstream and downstream drainage structures (Manholes, Catch Basins, and Inlets) shall be cleaned at the same time as the storm sewers are cleaned. The Contractor shall clean the drainage structures of all silt, debris and/or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection. Open lids or frames and grates shall be cleaned of all debris that may be clogging the open lid or frame and grate. The method of cleaning shall not damage the existing drainage structures and shall be submitted to the Engineer for approval. Any damage to the existing drainage structures shall be repaired by the Contractor at no additional cost to the Department. Cleaning of the upstream and downstream drainage structures will not be paid for separately but shall be included in the cost of Storm Sewers To Be Cleaned.

The Contractor shall dispose of the silt, debris and/or foreign matter removed from the existing box culverts and storm sewers offsite in accordance with Article 202.03 of the Standard Specifications.

Basis of Measurement and Payment. This work will be measured and paid for at the contract unit price per foot for STORM SEWERS TO BE CLEANED, of the diameter specified which includes all labor, equipment, tools, and disposal of materials, needed to complete the work as described above.

**ABANDON EXISTING WATERMAIN, FILL WITH CLSM**

Description. This work shall consist of filling abandoned water main at the locations shown on the plans and as directed by the Engineer. All water main pipes to be abandoned in place shall be completely filled with Controlled Low Strength Material (CLSM) per Section 1019 of the standard specification. The ends of the abandoned water main shall be cut, capped, and blocked with cement bricks and mortar, a poured concrete plug, or other means approved by the Engineer.

Method of Measurement. This work will be measured for payment in place in linear feet.

Basis of Payment. This work will be paid for at the contract unit price per linear foot for ABANDON EXISTING WATER MAIN, FILL WITH CLSM. This price shall include all costs for providing and injecting CLSM, capping, and other labor, equipment, and materials necessary to abandon and fill the pipe in accordance with the Specifications including sealing the ends of the abandoned storm sewer.

**MANHOLE WITH RESTRICTOR PLATE**

Description. This work shall consist of constructing a Manhole Type A of the diameter shown with two frames and lids with a restrictor plate as shown in the plan details and in accordance with Section 602 of the Standard Specifications.

Materials. Materials shall be in accordance with Section 602.02 of the Standard Specifications. Metal materials shall be in accordance with all applicable portions of Section 1006 of the Standard Specifications.

Basis of Payment. This work shall be paid for at the contract unit price per each for MANHOLES, TYPE A, 7'-DIAMETER, WITH 2 TYPE 1 FRAME, CLOSED LID, RESTRICTOR PLATE.

**MANHOLES, TYPE A, 10’ DIAMETER**

Description. Work under this item shall be performed according to Section 602 of the Standard Specifications, and in accordance with Standard Detail 602426-02 PRECAST MANHOLE, TYPE A 10' (3.05M) DIAMETER

Basis of Payment. This work will be paid for at the contract unit price per each for MANHOLES, TYPE A, 10’ -DIAMETER, TYPE 1 FRAME, CLOSED LID

**CATCH BASINS TYPE A 4' DIAMETER WITH SPECIAL FRAME AND GRATE**

Description. This work shall conform to Article 602 of the Standard Specifications except as herein modified:

General. Section 602.11(a) Furnishing. Casting shall be according to the Special Frame and Grate Casting Detail in tshe plans.

Basis of Payment. This work will be paid for at the contract unit price per each for CATCH BASINS TYPE A 4' DIAMETER WITH SPECIAL FRAME AND GRATE, which price shall be payment in full for all labor, equipment and materials necessary to complete the work as specified herein.

**INLET TYPE A WITH SPECIAL FRAME AND GRATE**

Description. This work shall conform to Article 602 of the Standard Specifications except as herein modified:

General. Section 602.11(a) Furnishing. Casting shall be according to the Special Frame and Grate Casting Detail in the plans.

Basis of Payment. This work will be paid for at the contract unit price per each for INLETS, TYPE A, WITH SPECIAL FRAME AND GRATE, which price shall be payment in full for all labor, equipment and materials necessary to complete the work as specified herein.

**TEMPORARY INLET**

Description. This item shall be constructed in accordance with Section 602 of the Standard Specifications for Road and Bridge Construction and details included in the plans.

Construction. This item includes all materials (concrete, reinforcement, frames, lids, etc.), labor and equipment necessary to construct, place for temporary use, and removal of the temporary inlet to the lines and grades shown within the plans.

Basis of Payment. This work shall be at the contract unit price per EACH for TEMPORARY INLET.

**FRAMES AND LIDS TO BE ADJUSTED (SPECIAL)**

Description. This work shall consist of adjusting frames and lids in asphalt pavement that is to be resurfaced.

Construction. Frames and lids that are to be adjusted shall be done according to IDOT's District 1 Detail "BD-08 Details for Frames and Lids Adjustment With Milling"

Method of Measurement. This work will be measured for payment per each.

Basis of Payment. This work will be paid for at the contract unit price per each for FRAMES AND LIDS TO BE ADJUSTED (SPECIAL).

**COMBINATION CONCRETE CURB AND GUTTER, TYPE B-6.12 (SPECIAL)**

Description. This work shall consist of the construction, removal and legal disposal of temporary combination concrete curb and gutter at the locations shown on the Maintenance of Traffic plans. This work shall be performed in accordance with the applicable portions of Section 440 and Section 606 of the Standard Specifications, the Highway Standards and details included in the plans and the following:

The temporary combination concrete curb and gutter shall not be tied to the adjacent existing, proposed or temporary pavements.

Method of Measurement. Temporary combination concrete curb and gutter will be measured for payment in feet in accordance with the first paragraph of Article 606.14 (b) except that the length of transitions to or from existing or proposed curb and gutter will be paid for as COMBINATION CONCRETE CURB AND GUTTER, TYPE B-6.12 (SPECIAL).

Basis of Payment. This work will be paid for at the contract unit price per foot for COMBINATION CONCRETE CURB AND GUTTER, TYPE B-6.12 (SPECIAL).

**CHAIN LINK FENCE REMOVAL**

Description. This work shall consist of the complete removal and disposal of existing fence at locations designated in the plans or as directed by the Engineer.

The Contractor shall remove the existing fence in a manner so as not to damage the adjacent fence that are to remain. Any damage to the fence to remain shall be repaired and/or replaced by the Contractor at his/her expense to the approval of the Engineer. Voids created from the removal of the fence shall be backfilled with a material similar to the material adjacent to the void, to the approval of the Engineer. The fence shall be disposed of in accordance with the applicable portions of Section 202 of the Standard Specifications.

Method of Measurement. Fence removal will be measured for payment in place and computed per FOOT.

Basis of Payment. This work shall be paid for at the contract unit price per FOOT for CHAIN LINK FENCE REMOVAL, which price shall include all labor and equipment necessary to remove, backfill, and dispose of the fence.

**CHAIN LINK FENCE ATTACHED TO STRUCTURE**

Description. This work shall consist of all labor, materials and equipment necessary for the mounting of a chain link fence on retaining walls, in accordance with the details and locations shown on the plans and the requirements of Section 664 of the Standard Specifications.

Construction Requirements. All posts shall be vertical when erected; the base plate shall be welded to the post at the proper angle to account for any slope along the top of the wall.

The fence fabric shall be Type IV, Class B (polyvinyl chloride (PVC)-coated steel) and shall be in accordance with Article 1006.27 of the Standard Specifications. The color of all PVC coatings shall be black.

The steel base plate shall meet the requirements of AASHTO M183.

Method of Measurement. Measurement shall be made along the top of the fence center to center of the end post, in feet, completed in place.

Basis of Payment. The work under this item will be paid at the contract unit price per foot for CHAIN LINK FENCE ATTACHED TO STRUCTURE, of the height specified, which shall include all labor, materials, and equipment necessary to perform the work as specified.

**TRAFFIC CONTROL AND PROTECTION (ARTERIALS)**

Specific traffic control plan details and Special Provisions have been prepared for this contract. This work shall include all labor, materials, transportation, handling and incidental work necessary to furnish, install, maintain and remove all traffic control devices required as indicated in the plans and as approved by the Engineer.

When traffic is to be directed over a detour route, the Contractor shall furnish, erect, maintain and remove all applicable traffic control devices along the detour route according to the details shown in the plans. All removed traffic control devices shall be restored to original condition when the detour is removed.

Method of Measurement: All traffic control (except Temporary and Short Term Pavement Markings) indicated on the traffic control plan details and specified in the Special Provisions will be measured for payment on a lump sum basis.

Basis of Payment: All traffic control and protection will be paid for at the contract lump sum price for TRAFFIC CONTROL AND PROTECTION (SPECIAL).

Temporary and short term pavement markings will be paid for separately unless shown on a Standard.

**WATER MAIN CASING PIPE**

Description. This work shall consist of furnishing and installing steel casing pipe at the locations shown on the plans where proposed water main crosses under existing storm sewer. The pay item shall include the following items:

1. Saw cutting full depth any abutting pavement to remain.
2. The excavating, transportation and disposal of surplus material and debris.
3. Installing casing pipes including spacers, filling casing pipe with pea gravel, and sealing pipe ends as specified.

Method of Measurement. This work will be measured for payment in place in linear feet.

Basis of Payment. This work will be paid for at the contract unit price per linear foot for WATER MAIN CASING PIPE.

**SPECIAL PROVISIONS FOR PUMP STATION**
**DIVISION 1 - GENERAL REQUIREMENTS**

**SECTION 01 01 00 – SUMMARY OF WORK**

**PART 1 GENERAL:**

1.1 GENERAL WORK

A. The requirement of Division 1, General Requirements, shall apply to all Pump Station Work.

1.2 PUMP STATION GENERAL WORK

A. The Pump Station General Work shall include, but not be limited to, the following and shall be paid for under the pay item PUMP STATION GENERAL WORK:

1. All cast-in-place concrete as indicated in the drawings and as specified in Section 03 30 33, Cast-In-Place Concrete.
2. All prestressed hollowcore plank as indicated on the drawings and as specified in Section 03 41 13, Prestressed Hollowcore Plank.
3. All grout as indicated on the Drawings and as specified in Section 03 60 00, Grout.
4. All unit masonry work consisting of glass block work and faced brickwork as indicated on the Drawings and as specified in Section 04 10 00, Unit Masonry.
5. All cast stone masonry work as indicated on the drawings and as specified in Section 04 72 00, Cast Stone Masonry.
6. All miscellaneous metal work as indicated on the Drawings and as specified in Division 5, Metals.
7. All carpentry work as indicated on the Drawings and as specified in Section 06 10 00, Rough Carpentry.
8. All fiberglass reinforced plastic products and fabrications as indicated on the Drawings and specified in Section 06 60 00, Fiberglass Reinforced Plastic Products And Fabrications.
9. All board insulation as indicated on the Drawings and specified in Section 07 20 00, Board Insulation
10. All mineral wool insulation as indicated on the drawings and specified in Section 07 21 10, Mineral Wool Insulation.
11. All asphalt shingle as indicated on the drawings and specified in Section 07 31 13, Asphalt Shingles
12. All sheet metal work as indicated on the Drawings and as specified in Section 07 62 00, Sheet Metal Flashing and Trim.
13. All sealant work as indicated on the Drawings and as specified in Section 07 92 00, Joint Sealers.
14. All doors, hardware, glass, and glazing as indicated on the Drawings and as specified in Division 8, Doors and Windows.

15. All louvers and vents as indicated on the drawings and specified in Section 08 90 00, Louvers and Vents.
16. All painting as indicated on the Drawings and as specified in Section 09 91 00, Painting.
17. The station identification plate, shop desk, bulletin board, staff gauges, first aid kit, fire extinguishers, electric clock and trash can as indicated on the Drawings and as specified in Section 10 00 00, Specialties.
18. The Bridge Crane as indicated on the Drawings and as specified in Section 41 22 13, Bridge Crane.

1.3 STRUCTURAL WORK

A. The requirements of the Special Provisions and Division 1, General Requirements, shall apply to the work described herein.

1. All sheet waterproofing membrane systems as indicated on the drawings and as specified in Section 07 13 26.
2. All dewatering as indicated on the drawings and as specified under the “DEWATERING” specification.

1.4 MECHANICAL WORK

A. The requirements of the Special Provisions and Division 1, General Requirements, shall apply to all Pump Station Mechanical Work described herein.

B. The Pump Station Mechanical Work shall include, but not be limited to, the following and shall be paid for under the pay item PUMP STATION MECHANICAL WORK:

1. The Pump Station Mechanical Work shall include, but not be limited to, furnishing and installing the following items as indicated on the Project Drawings and in the Special Provisions:
2. New pump discharge and suction piping, fittings, wall castings, and appurtenances.
3. New valves and appurtenances as indicated; including but not limited to, knife gates valves installed on the pump suction piping, and any valves required for installation on ancillary piping. Manual or electric motor actuators for valves shall also be included.
4. All required pipe and equipment support systems, hangers, and appurtenances; required for the installation of all piping, pumps, valves, and other mechanical items.
5. New metal bar rack, including appurtenant items.
6. Any miscellaneous mechanical items that are ancillary to the Work described above.

1.5 HEATING AND VENTILATION

A. The requirement of Division 1, General Requirements, shall apply to all Heating and Ventilation Work.

B. The Pump Station Mechanical Work shall include, but not be limited to, the following and shall be paid for under the pay item HEATING AND VENTILATION WORK:

1. New ventilation system including, but not limited to, exhaust fans, supply fans, duct work, unit heaters, louvers, dampers, actuators, controls, control wiring and all associated appurtenances.

1.6 ELECTRICAL

A. The requirements of Division 1, General Requirements, shall apply to all Pump Station Electrical Work.

B. The Pump Station Electrical Work shall include, but not be limited to, the following and shall be paid for under the pay item PUMP STATION ELECTRICAL WORK:

1. Disconnection and removal of existing electric service, including all metering.
2. Installation and connection of a new electric service including all metering in accordance with ComEd Electric Requirements.
3. Installation of new disconnect switches and motor starters.
4. Removal of existing disconnect switches and motor starters.
5. New lighting fixtures, lighting panel board, lighting transformer and wiring devices.
6. New power, lighting, control and signal wires and cables.
7. New conduit and raceway system.
8. New electric heaters, complete.
9. New float type level sensing control system.
10. New combustible gas detectors, fire detection system and intrusion alarm system.
11. Branch wiring and conduit for main pumps, low flow pumps, unit heaters, ventilation system, and other electrical equipment as shown on the Drawings.
12. Pavement flood float sensing system.
13. Testing of electrical equipment.

1.7 INSTRUMENT AND CONTROL

A. The requirement of Division 1, General Requirements, shall apply to all Pump Station SCADA Equipment work.

B. The Pump Station Electrical Work shall include, but not be limited to, the following and shall be paid for under the pay item PUMP STATION SCADA EQUIPMENT:

1. The SCADA (Supervisory Control and Data Acquisition) system shall be provided to function as the "Master Control Station" for the Pump Station facility.
2. The SCADA will be a PLC based system with an operator interface mounted on the SCADA panel for control, monitoring and system configuration. The following equipment and instrumentation, as a minimum, will be monitored/controlled:
    a. Automatic Transfer Switch
    b. Pump Motor Controllers and Protection Devices
    c. Motor Run Equalizing Devices
    d. Level Sensing Systems
    e. Pavement Float Switches
    f. Flow Monitoring System
3. The Operator Interface shall consist of a graphical interface which provides a view of the pumping station. Several “screens” shall be designed in order to display the features of the facility.
4. In addition the screens that shall be developed for the pump station Operator Interface, screens shall be developed for the City of Lake Forest monitoring interface. The screens shall be similar to the graphics currently displayed for the other pump stations.
5. The CONTRACTOR shall provide all programming and configuration of equipment and software including development of graphic displays and reports. Displays and Report development shall be coordinated with existing Department standards.

## 1.8 ADDRESSABLE FIRE ALARM SYSTEM

A. The requirements of the Special Provisions and Division 1, General Requirements, shall apply to the work described herein.

    1. All addressable fire alarm systems as indicated on the drawings and as specified in Section 28 46 21.11.

## 1.9 GAS DETECTION PANEL

A. The requirements of the Special Provisions and Division 1, General Requirements, shall apply to the work described herein.

B. All gas detection systems as indicated on the drawings and as specified in Section 28 31 00.

## 1.10 MOTOR CONTROL CENTER

A. The requirements of the Special Provisions and Division 1, General Requirements, shall apply to the work described herein.

1. All motor control centers as indicated on the drawings and as specified in Section 26 24 19.

1.11 BACKUP GENERATOR

A. The requirements of the Special Provisions and Division 1, General Requirements, shall apply to the work described herein.

1. All backup generators as indicated on the drawings and as specified in Section 26 32 13.16.

1.12 PUMPS

A. The requirements of the Special Provisions and Division 1, General Requirements, shall apply to the work described herein.

1. All main pumps as indicated on the drawings and as specified in Section 43 21 39.
2. Low flow pump as indicated on the drawings and as specified in Section 43 21 39.

**PART 2 EXECUTION:**

2.1 SUBMITTALS

A. Except as specified elsewhere herein, materials and equipment shall be in conformance with the requirements of Section 106 of the Standard Specifications.

B. Except as specified elsewhere herein, all submittal requirements in this section shall apply for all Special Provisions for Pump Station items.

C. OWNER shall refer to both the Illinois Department of Transportation and the City of Lake Forest.

D. ENGINEER, CONTRACTOR, and Subcontractor, are defined in Section 101.01 of the Standard Specifications.

E. Materials and equipment shall be the products of established and reputable manufacturers and shall be suitable for the service required. Unless otherwise specifically indicated, all materials and equipment shall be new. The CONTRACTOR is obligated to conduct his own search into the timely availability of the specified equipment and materials to ensure that they are in strict conformance with the contract documents and that delivery schedules are compatible with project time constraints. Materials or equipment items which are similar or identical shall be the product of the same manufacturer. The cost of submittals, certifications, any required samples, and

similar costs shall not be separately paid for but shall be included in the pay item bid price for the respective material or work.

F. All equipment, products, and materials incorporated in the work shall be submitted for approval.

G. Specific submittals required for individual elements of work are specified in the individual Specification sections. Except as otherwise indicated in Specification sections, requirements specified herein shall apply for each indicated type of submittal. Procedures concerning items such as a listing of manufacturers, suppliers, Subcontractors, construction progress schedule, schedule of Shop Drawing submissions, bonds, payment applications, insurance certificates, and schedule of values are specified elsewhere.

H. WORK RELATED SUBMITTALS
   1. Substitution or "Or Equal" Items include material or equipment CONTRACTOR requests ENGINEER to accept, after Bids are received, as substitute for items specified or described in Specifications by using name of a proprietary item or name of particular supplier.
   2. Shop Drawings include technical data and drawings specially prepared for this Project, including fabrication and installation drawings, diagrams, actual performance curves, data sheets, schedules, templates, patterns, reports, instructions, design mix formulas, measurements, and similar information not in standard printed form. Standard information prepared without specific reference to the Project is not considered a Shop Drawing.
   3. Product Data includes standard printed information on manufactured products and systems that has not been specially prepared for this project, including manufacturer's product specifications and installation instructions, catalog cuts, standard wiring diagrams, printed performance curves, mill reports, and standard color charts.
   4. Samples include both fabricated and manufactured physical examples of materials, products, and units of work, partial cuts of manufactured or fabricated work, swatches showing color, texture, and pattern, and units of work to be used for independent inspection and testing. Mock-ups are special forms of samples, which are too large or otherwise inconvenient for handling in a manner specified for transmittal of sample submittals.
   5. Miscellaneous Submittals are work-related submittals that do not fit in the previous categories, such as guarantees, warranties, certifications, experience records, maintenance agreements, Operating and Maintenance Manuals, workmanship bonds, survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, and similar information, devices, and materials applicable to the Work.

I. The CONTRACTOR shall thoroughly review submittal and ensure that the submittal is complete and meets all the requirements of the contract documents. Any shop drawing submitted more than two times requires the CONTRACTOR to be charged for all costs included by the Department.

J. SCHEDULING
   1. A preliminary schedule of shop drawings and sample submittals shall be submitted for approval, in duplicate.

2. Prior to final payment, the original and one copy of all bonds, warranties, guarantees, and similar documents, including those customarily provided by manufacturers and suppliers which cover a period greater than the one year correction period shall be delivered to the OWNER.
3. Within 60 days of the contract award, the CONTRACTOR shall submit, for approval, complete manufacturer's product data (for standard products and components) and detailed shop drawings (for fabricated equipment). Submittals need not include all project equipment and materials in one submittal; however, the submittals for the equipment and materials for each individual pay item shall be complete in every respect. Partial submittals may be returned without review. The CONTRACTOR may request, in writing, permission to make a partial submittal; the ENGINEER will evaluate the circumstances of the request and may accept to review such partial submittal. However, no additional compensation or extension of time will be allowed for extra costs or delays incurred due to partial or late submittals.

K. Each submittal shall be accompanied by a transmittal containing the following information:
   1. CONTRACTOR’s Name
   2. Supplier’s Name
   3. Manufacturer’s Name
   4. Date of submittal and dates of previous submittals containing the same material
   5. Project Route/Name
   6. Section
   7. Submittal and transmittal number
   8. Contract identification
   9. Identification of equipment and material with equipment identification numbers, motor numbers, and Specification section number. Variations from Contract Documents and any limitations which may impact the Work Drawing sheet and detail number as appropriate
   10. Variations from Contract Documents and any limitations which may impact the Work.
   11. Drawing sheet and detail number as appropriate. Multi-part submittal forms will be provided by the Department to the CONTRACTOR to facilitate the submittal and review process. The CONTRACTOR shall complete all submittal information on the form and shall sign the submittal as indicated
   12. The resubmittal shall be complete in all respect and shall supersede earlier submittal in entirety and should not require referring to earlier multiple piece meal submittals.
   13. Each submittal shall be dedicated for each subject. The different subjects and or systems associated with different engineering disciplines shall not be combined or mixed up together in one package of submittal.

L. Exceptions, Deviations, and Substitutions
   1. In general, exceptions to and deviations from the requirements of the Contract Documents will not be allowed. It is the CONTRACTOR's responsibility to note any deviations from Contract requirements at the time of submittal and to make any requests for deviations in writing. In general, substitutions must demonstrate that the proposed substitution is superior to the equipment or material required by the Contract Documents. No exceptions, deviations, or substitutions will be permitted without approval.

2. Data for items to be submitted for review, as substitution shall be collected into one submittal for each item of material or equipment.
3. Request shall be submitted with other scheduled submittals for the material or equipment allowing time for ENGINEER to evaluate the additional information required to be submitted. If CONTRACTOR requests to substitute for material or equipment specified but not identified in Specifications as requiring submittals, substitution submittal request shall be included in Submittal schedule and submitted as scheduled.

M. Shop Drawings
1. Shop drawing information shall be newly prepared and submitted with graphic information at accurate scale. The name of manufacturer or supplier (firm name) shall be indicated. Dimensions shall be shown and clearly noted which are based on field measurement; materials and products that are included in the Work shall be identified; revision shall be identified. Compliance with standards and notation of coordination requirements with other work shall be indicated. Variations from Contract Documents or previous submittals shall be highlighted, encircled or otherwise indicated.
2. The catalog cuts shall be highlighted identifying all selected options and project specific details. Generic catalog cuts shall be unacceptable.
3. Any deviation hidden in the submittals shall be unacceptable. The deviations if any shall be highlighted and CONTRACTOR shall provide cost analysis justifying equal or better product. The ENGINEER shall be the sole authority for the acceptance or rejection without any justification.
4. List all shop drawings that are required for each discipline.
5. Each major equipment submittal shall have a detailed bill of material list.
6. The following information shall be included on each drawing or page:
    a. Submittal date and revision dates.
    b. Project name, division number and descriptions.
    c. Detailed specifications section number and page number.
    d. Identification of equipment, product or material.
    e. Name of CONTRACTOR and Subcontractor.
    f. Name of Supplier and Manufacturer.
    g. Relation to adjacent structure or material.
    h. Field dimensions, clearly identified.
    i. Standards or Industry Specification references.
    j. Identification of deviations from the Contract Documents.
    k. CONTRACTOR's stamp, initialed or signed, dated and certifying to review of submittal, certification of field measurements and compliance with Contract.
    l. Physical location and location relative to other connected or attached material at which the equipment or materials are to be installed.
7. An 8-inch by 3-inch blank space shall be provided for CONTRACTOR and ENGINEER stamps.
8. Five submittal copies shall be submitted to the ENGINEER for review. CONTRACTOR will be responsible for distribution and pick-up of submittals as directed by the ENGINEER. One approved copy will be returned to the CONTRACTOR
9. Materials, products or systems shall not be installed until copy of applicable product data showing only approved information is in possession of installer. One set of product data (for each submittal) shall be maintained at Project site. Five

additional copies shall be marked with the date of approval and forwarded to the ENGINEER for use in field and for OWNER'S records.

10. Shop drawing submittal shall include pump control schematics, SCADA panel drawings, and detailed control system descriptions for auto/manual controls and operation and monitoring and monitoring of main and low flow pumps from the SCADA Panel and from the float control mode and also remote monitoring system descriptions.

N. Product Data
   1. Required product data shall be collected into a single submittal for each element of work or system. Where product data has been printed to include information on several similar products, some of which are not required for use on Project or are not included in submittal, copies shall be marked to clearly show such information is not applicable.
   2. Where product data must be specially prepared for required products, materials or systems, because standard printed data are not suitable for use, data shall be submitted as a Shop Drawing and not as product data.
   3. Submittal is for information and record, and to determine that products, materials, and systems comply with Contract Documents. Submittal shall be final when returned by ENGINEER marked "Approved".
   4. Four submittal copies, in addition to the number the CONTRACTOR requires returned, including those required for RECORD DRAWINGS, shall be submitted to the ENGINEER.
   5. Materials, products or systems shall not be installed until copy of applicable product data showing only approval information is in possession of installer. One set of product data (for each submittal) shall be maintained at Project site, available for reference by ENGINEER and others.

O. Samples
   1. Where possible, samples shall be physically identical with proposed materials or products to be incorporated into the Work. Where variations in color, pattern or texture are inherent in material or product represented by sample, multiple units (not less than 3 units) shall be submitted showing approximate limits of variations.
   2. A full set of optional samples shall be provided where ENGINEER's selection required. Samples shall be prepared to match ENGINEER's selection where so indicated.
   3. Each sample shall include generic description, source or product name and manufacturer, limitations, and compliance with standards.
   4. Samples for ENGINEER's visual review and final check of coordination of these characteristics with other related elements of work shall be of general generic kind, color, pattern, and texture.
   5. At CONTRACTOR's option, and depending upon nature of anticipated response from ENGINEER, initial submittal of samples may be either preliminary or final submittal.

      A preliminary submittal, consisting of a single set of samples, is required where specifications indicate ENGINEER's selection of color, pattern, texture or similar characteristics from manufacturer's range of standard choices is necessary. Preliminary submittals will be reviewed and returned with ENGINEER's "Action" marking.

      Three sets of samples shall be submitted in final submittal, one set will be returned.

6. The returned final set of samples shall be maintained at Project site, in suitable condition and available for quality control comparisons throughout course of performing work.
   Returned samples intended or permitted to be incorporated in the Work are indicated in Specification sections, and shall be in undamaged condition at time of use.

P. Mock-ups and similar samples specified in Specification sections are recognized as special type of samples. Requirements for sample submittal shall be complied with to greatest extent possible. Transmittal forms shall be processed to provide record of activity.

Q. Miscellaneous Submittals
   1. Inspection and Test Reports
      a. Each inspection and test report shall be classified as either "Shop Drawings" or "product data", depending on whether report is specially prepared for Project or standard publication of workmanship control testing at point of production. Inspection and test reports shall be processed accordingly.
   2. Guarantees, Warranties, Maintenance Agreements, and Workmanship Bonds
      a. Refer to Specification sections and section Guarantees and Warranties of this Division for specific requirements. Submittal is final when returned by ENGINEER marked "Approved" or "Approved as Noted".
      b. In addition to copies desired for CONTRACTOR's use, 2 executed copies shall be furnished. Two additional copies shall be provided where required for maintenance data.
   3. Certifications
      a. Refer to Specification sections for specific requirements on submittal of certifications. Seven copies shall be submitted. Certifications are submitted for review of conformance with specified requirements and information. Submittal shall be final when returned by ENGINEER marked "Approved".
      b. Where certifications are specified, the information submitted for approval shall incorporate certification information. When a certification can be made prior to manufacture, the certification shall be included with initial submittal information. When certification is possible only after manufacture, the initial submittal information shall include a statement of intent to furnish the certification after equipment approval and manufacture. Certifications involving inspections and/or tests shall be complete with all test data presented in a neat, descriptive format, with all test data, applicable dates, times, and persons responsible.
   4. Tools
      a. Spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units shall be submitted.
      b. Special tools are considered to be those tools which, because of their limited use, are not normally available but which are necessary for maintenance of particular equipment.
      c. For each type of equipment provided under this CONTRACT, a complete set of all special tools shall be furnished including grease guns and other lubricating devices, which may be needed for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be of high

grade, smooth forged alloy tool steel. Grease guns shall be of the lever type.

d. One or more neat and substantial steel wall cases or cabinets shall be furnished and erected with flat key locks and clips or hooks to hold each special tool in a convenient arrangement.

R. CONTRACTOR's Stamp
1. Prior to submittal, the CONTRACTOR shall review the submittal material and shall affix his stamp of approval, with comments as applicable, signed by a responsible representative, to each appropriate submittal item. In the case of Subcontractor's submittals, both the Sub- CONTRACTOR and the General CONTRACTOR shall review and stamp the submittal. Submittals which are not approved or approved-as-noted by the CONTRACTOR shall not be submitted to the ENGINEER. The CONTRACTOR shall not give an approved-as-noted status to submittals having incompleteness or major corrective notations as this will only delay the ultimate approval process.
2. The receipt of submittal information from the CONTRACTOR will be construed as the CONTRACTOR's assurance that he has reviewed the submittal information and attests to the submittal's accuracy and conformance to the requirements of the contract documents. Submitted information shall be complete and in sufficient detail to demonstrate compliance with all requirement of the contract documents, including fitting in the space provided and meeting all salient features of the specifications.

S. Submittal information must be particularly detailed in every respect. Product data shall present information to demonstrate the complete nature of the product, including dimensions, wiring diagrams, operating information, and the like. Shop drawings shall be extremely detailed and shall include all appropriate dimensions, fabrication details, component bill of material, information relative to mounting, detailed wiring, finish, and the like. Wiring diagrams shall include both schematic and point-to point representations, complete with references to circuiting as indicated on the Contract Drawings as well as terminal points of component devices.

T. Unless required elsewhere, submittals shall be distributed to Subcontractors, suppliers, governing authorities, and others as necessary for proper performance of work.

U. Except for submittals for record and similar purposes, where action and return on submittals are required or requested, ENGINEER will review each submittal, mark with appropriate action, and return. Where submittal must be held for coordination, ENGINEER will also advise CONTRACTOR without delay. ENGINEER will stamp each submittal with uniform, self-explanatory action stamp, appropriately marked with submittal action.

V. Where submittals are marked "Approved", Work covered by submittal may proceed <u>PROVIDED IT COMPLIES WITH CONTRACT DOCUMENTS</u>. Acceptance of Work will depend upon that compliance.

W. When submittals are marked "Approved as Noted" or "Approved Subject to Corrections Marked", Work covered by submittal may proceed provided it complies with both ENGINEER's notations or corrections on submittal and with Contract

Documents. Acceptance of Work will depend on that compliance. Re-submittal is not required.

X. When submittals are marked "Examined and Returned for Correction or disapproved", Work covered by submittal shall not proceed. Work covered by submittal shall not be used at Project site or elsewhere where Work is in progress. The submittal shall be revised or a new submittal shall be prepared in accordance with ENGINEER's notations in accordance with Re-submittal Preparation procedures specified in this section. The submittal shall be resubmitted without delay and repeated if necessary to obtain different action marking.

Y. Any need for more than one resubmission, or any other delay in ENGINEER's review of submittals, will not entitle CONTRACTOR to extension of the Contract Time.

Z. Coordination
   1. Preparation and processing of submittals shall be coordinated with performance of the work, other submittals and related activities such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities that require sequential activity.
   2. Submission of different units of interrelated work shall be coordinated so that one submittal will not be delayed by ENGINEER's need to review a related submittal. ENGINEER may withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.

AA. Unless otherwise indicated, guarantees as specified herein shall be included with the submittal information of all applicable equipment and materials. Incompleteness, inaccuracy, or lack of coordination shall be grounds for rejection. The CONTRACTOR shall clearly understand no equipment or material shall be installed prior to approval and that any equipment or material installed prior to approval is subject to removal from the right-of-way solely at the CONTRACTOR's expense.

BB. Re-submittal Preparation
   1. Re-submittal Preparation shall comply with the requirements described in subsection 2.1, Submittals, of this section. In addition, it shall be identified on the transmittal form that the submittal is a resubmission.
   2. Any corrections or changes in submittals required by ENGINEER's notations shall be made on returned submittal.
   3. On the transmittal or on a separate page attached to CONTRACTOR's resubmission transmittal, all notations or questions indicated by ENGINEER on ENGINEER's transmittal form shall be answered or acknowledged in writing. Each response shall be identified by question or notation number established by ENGINEER. If CONTRACTOR does not respond to each notation or question, resubmission will be returned without action by ENGINEER until CONTRACTOR provides a written response to all ENGINEER's notations or questions.
   4. Variations or revisions from previously reviewed submittal, other than those called for by ENGINEER, shall be identified on transmittal form.

## 2.2 GUARANTEES AND WARRANTIES

A. All equipment shall be furnished complete with the manufacturer’s standard trade guarantee or warranty, applicable to the Illinois Department of Transportation and the

City of Lake Forest, from the date of final acceptance. Such warranty shall accompany submittal shop drawings and product data.

B. Prior to final payment, the original and one copy of all bonds, warranties, guarantees, and similar documents, including those customarily provided by manufacturers and suppliers which cover a period greater than the one year correction period shall be delivered to the OWNER.

C. The warranties shall include parts and labor and shall begin from the date of final acceptance.

2.3 OPERATION AND MAINTENANCE MANUALS

A. Four copies of an Operation and Maintenance Manual shall be furnished to the ENGINEER for all equipment and associated control systems furnished and installed for review and approval. Four hard copies of approved O&M manuals and four scanned O&M Manuals CD's shall be submitted for ENGINEER's use.

B. The CONTRACTOR shall submit four manuals for the ENGINEER, Designer, IDOT Bureau of Electric, and City of Lake Forest independent review when construction is at 75% complete stage. Based on the consolidated review comments and compliance, the CONTRACTOR shall organize and compile the required number of sets of O&M manuals and resubmit for review and approval along with point to point response to the previous comments. If it is determined by the ENGINEER that the manuals does not contain required details and are not revised per the previous comments, then all manuals shall be returned back to the CONTRACTOR for corrective action until the manuals are approved by the ENGINEER. Any missing material for the manual shall be submitted prior to requesting certification of substantial completion. Substantial completion is not achieved until Operations and Maintenance Manuals are approved by the ENGINEER.

C. Each copy of the manual shall consist of the following and shall be prepared and arranged as follows:

1. Table of Contents broken down per discipline.
2. A section of a pump station data sheet (see sample form at end of section.
3. A section of an equipment data summary (see sample form at end of section) for each item of equipment.
4. A section of an equipment preventive maintenance data summary (see sample form at end of section) for each item of equipment.
5. A section of the equipment manufacturer's operating and maintenance instructions. Operating instructions include equipment start-up, normal operation, shutdown, emergency operation and troubleshooting. Maintenance instructions include equipment installation, calibration and adjustment, preventive and repair maintenance, lubrication, troubleshooting, parts list and recommended spare parts.
6. Approved power systems study including list of electrical relay settings and control, alarm contact, and timer settings with applicable ranges.
7. Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems.
8. One valve schedule giving valve number and location for each valve installed.

9. All O&M Manual material and catalog pages shall be on 8-1/2 inch by 11 inch commercially printed or typed forms or an acceptable alternative format.
10. Comprehensive equipment technical data sheets for pumps , motors, equipment within switchgear, MCC, switchgear, transformers, breakers, valves, SCADA and control panel.
11. Details of equipment nameplates and technical ratings.
12. Detailed summary of quantities and bill of material with technical descriptions for major equipment such as MCC, switchgear, SCADA, and control panels, etc.
13. The manuals shall contain catalog cuts highlighting features and selected options of the equipment.
14. Legible 11 inch x 17 inch shop drawing and each shop drawing shall have "Record" stamp, signatures and date.
15. The catalog cuts of each device/equipment shall have ENGINEER's "Approved" stamp, signature and elate.
16. The manual shall include shop drawings of SCADA, control panels, MCC, switchgear, front and internal views, internal wiring and field interconnection termination details/terminal schedules.
17. The manual shall have CAD produced contract drawings having changes identified by red ink and contract documents shall have "Record" stamp, signature and date.
18. The manual shall include control schematic shop drawings for pumps and discharge/recirculation gate valves.
19. Mechanical and HVAC equipment schedules.
20. The manual shall contain a section for detailed system description of sequence of pump operations during rising and falling wet well water level through SCADA primary and backup level controls, float mode control, manual and auto operation of various level systems, remote monitoring of pump station signals and communications method.
21. All documents shall be legible.
22. The manual shall include shop drawings having ENGINEER's approved stamp, signature and date.
23. The manual shall include section for field test reports for all major equipment including the MCC, generator, grounding system, SCADA, and all other monitoring and control equipment.
24. Four copies of Record Drawings shall be submitted to the ENGINEER for review.
25. Successful bidder will be provided with MicroStation drawings upon receipt of acceptable release.

D. Each manual shall be organized into sections paralleling the equipment specifications. Each section shall be identified using heavy section dividers with reinforced holes and numbered plastic index tabs. The data shall be compiled in high-quality heavy-weight, hard cover binders with piano style metal hinges or in an alternate approved format. Large drawings and other materials which would be opened or removed for reading shall be provided with heavy clear plastic pouches within the binders. The number of binders shall be as required to hold all required material without over-filling. Various sections, as appropriate shall have suitable dividers. All volumes shall be labeled. All loose data shall be punched for binding. Composition and printing shall be arranged so that punching does not obliterate any data. The project title, and manual title, as furnished and approved by the ENGINEER shall be printed on the cover and binding edge of each manual.

E. All operating and maintenance material that comes bound by the equipment manufacturer shall be left in its original bound state. The appropriate sections of the

CONTRACTOR's O&M manual shall be cross-referenced to the manufacturers' bound manuals.

F. The O&M Manuals must be submitted and must be acceptable to the ENGINEER prior to equipment start-up. Substantial completion is not achieved until O&M Manuals are approved by the ENGINEER.

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STORMWATER PUMP STATION NO. 38

Operation and Maintenance Manual

Equipment Data Summary

Equipment Name: Specification Reference:

Manufacturer

Name:

Address:

Telephone:

Number Supplied: Location/Service:

Model No: Serial No:

Type:

Size/Speed/Capacity/Range (as applicable):

Power Requirement (Phase/Volts/Hertz):

Local Representative

Name:

Address:

Telephone:

NOTES:

DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

STORMWATER PUMP STATION NO. 38

Operation and Maintenance Manual

Preventive Maintenance Summary

| Equipment Name: | Location: | O&M Manual Reference |
|---|---|---|

Manufacturer:

Name:

Address:

Telephone:

Model No: Serial No:

| Maintenance Task | Lubricant/Part | D W M Q SA A |
|---|---|---|

NOTES:

*D-Daily W-Weekly M-Monthly Q-Quarterly SA-Semi-annual A-Annual

2.4 RECORD DRAWINGS

A. One record copy of all Contract Documents, reference documents and all technical documents submitted in good order shall be kept and maintained at the site. On mylar tracing media, and using drafting symbols and standards consistent with the original documents, Contract Drawings shall be annotated in red to show all changes made during the construction period. Annotated drawings are to be made available to ENGINEER for reference at all times.

B. At completion of the CONTRACT and before final payment is made, three (3) sets of clearly legible 11”x17” Contract Drawings reflecting all changes made during construction shall be delivered to the IDOT CAD DEPARTMENT. The drawings shall each be stamped "RECORD DRAWING", and shall be marked with the CONTRACTOR's stamp, the date, and the signature of the CONTRACTOR's representative. In addition, one (1) CD containing electronic version of these documents in PDF format shall be provided. Refer to individual sections for addition requirements.

C. The Record Drawings must be submitted and must be acceptable to the ENGINEER prior to final acceptance.

**END OF SECTION 01 01 00**

**DIVISION 1 - GENERAL REQUIREMENTS**

**SECTION 01 01 10 – MEASUREMENT AND PAYMENT**

**Part 1 – GENERAL:**

A. Standard IDOT pay items which do not have a special provision shall be measured and paid for according to the Standard Specifications.

B. The following pay items shall be measured and paid for as described below. Each pay item shall include all labor, materials, tools, equipment and incidentals and for performing all work required.

a. EROSION CONTROL BLANKET shall be measured and paid for at the contract unit price per square yard as specified in the Special Provisions for Civil Items.

b. STORM SEWERS, RUBBER GASKET of the diameter specified shall be measured and paid for at the contract unit price per foot as specified in the Special Provisions for Civil Items.

c. STORM SEWERS JACKED IN PLACE, 54” shall be measured and paid for at the contract unit price per foot as specified in the Special Provisions for Civil Items.

d. HOT-MIX ASPHALT DRIVEWAY PAVEMENT of the thickness specified shall be measured and paid for at the contract unit price per square yard as specified in the Special Provisions for Civil Items.

e. WELDED WIRE FABRIC 6X6 shall be measured and paid for at the contract unit price per square yard as specified in the Special Provisions for Civil Items.

f. CLEANING DRAINAGE SYSTEM shall be measured and paid for at the contract unit price per lump sum as specified in the Special Provisions for Civil Items.

g. DRAINAGE SYSTEM shall be measured and paid for at the contract unit price per lump sum as specified in the Special Provisions for Civil Items.

h. DRILL AND GROUT DOWEL BARS shall be measured and paid for at the contract unit price per each as specified in the Special Provisions for Civil Items.

i. STORM SEWER (WATER MAIN REQUIREMENTS), of the diameter specified shall be measured and paid for at the contract unit price per foot as specified in the Special Provisions for Civil Items.

j. PUMP STATION SCADA EQUIPMENT shall be paid for at the contract lump sum price as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements under Division 40, SCADA System.

k. STORM SEWER TO BE FILLED shall be measured and paid for at the contract unit price per foot as specified in the Special Provisions for Civil Items.

l. MAINTENANCE OF EXISTING PUMP STATION DURING CONSTRUCTION shall be measured and paid for at the contract unit price per lump sum as specified in the Special Provisions for Civil Items.

m. LOW FLOW PUMP shall be paid for at the contract unit price per each as specified in the applicable requirements Division 1, General Requirements and Division 41, Liquid Handling Equipment.

n. MAIN PUMPS shall be paid for at the contract unit price per each as specified in the applicable requirements Division 1, General Requirements and Division 41, Liquid Handling Equipment.

o. SHEET WATERPROOFING MEMBRANE SYSTEM shall include all work which is not listed as a specific pay item but which is required for compliance with the specifications and for a complete operational facility and will be paid for at the contract lump sum price as specified in the Special Provisions; Division 1, General Requirements; and the applicable requirements under Division 7, Thermal and Moisture Protection.

p. TELEVISION INSPECTION OF SEWER shall be measured and paid for at the contract unit price per foot as specified in the Special Provisions for Civil Items.

q. ADDRESSABLE FIRE ALARM SYSTEM shall be paid for at the contract lump sum price as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements under Division 40, SCADA System.

r. ELASTOMERIC CHECK VALVE of the specified diameter shall be measured and paid for at the contract unit price per each as specified in the Special Provisions for Civil Items.

s. HEATING AND VENTILATION WORK shall be paid for at the contract lump sum as specified in Division 23, Heating and Ventilation and Air Conditioning.

t. GAS UTILITY SERVICE CONNECTION shall be measured and paid for at the contract unit price per square yard as specified in the Special Provisions for Civil Items.

u. DRIVEWAY REMOVAL AND REPLACEMENT shall be measured and paid for at the contract unit price per square yard as specified in the Special Provisions for Civil Items.

v. PUMP STATION GENERAL WORK shall include all work which is not listed as a specific pay item but which is required for compliance with the specifications and for a complete operational facility and will be paid for at the contract lump sum price as specified in the Special Provisions; Division 1, General Requirements; and the applicable requirements under the following: Division 2, Site Work; Division 3 Concrete; Division 4, Masonry System; Division 5, Metals, Division 6, Carpentry; Division 7, Thermal and Moisture Protection; Division 8, Doors and Windows; Division 9, Painting; Division 10, Specialties; and Division 41 Material Processing & Handling Equipment.

w. DEWATERING shall be measured and paid for at the contract unit price per lump sum as specified in the Special Provisions for Civil Items.

x. PUMP STATION ELECTRICAL WORK will be paid for at the contract lump sum as specified in the applicable requirements of the Special Provisions and Division I, General Requirements and all requirements under Division 26, Electrical and Division 40, SCADA System.

y. PUMP STATION MECHANICAL WORK will be paid for at the contract lump sum as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements under Division 40, SCADA System and Division 43, Liquid Handling Equipment.

z. TEMPORARY SUPPORT SYSTEM (TO REMAIN IN PLACE) shall be measured and paid for at the contract unit price per each as specified in the Special Provisions for Civil Items.

aa. PUMP STATION PACKAGE ENGINE GENERATOR SYSTEMS will be paid for at the contract lump sum as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements under Division 23 Heating and Ventilation and Air Conditioning; Division 26, Electrical; and Division 40, SCADA System.

bb. PUMP STATION MOTOR CONTROL CENTER will be paid for at the contract lump sum as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements under Division 26, Electrical and Division 40, SCADA System.

cc. GAS DETECTION PANEL shall be paid for at the contract lump sum price as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements under Division 40, SCADA System.

dd. INLET FILTER CLEANING shall be measured and paid for at the contract unit price per each as specified in the Special Provisions for Civil Items.

ee. DEMOLITION OF EXISTING PUMP STATION will be paid for at the contract lump sum as specified in the applicable requirements of the Special Provisions and Division 1, General Requirements and all requirements under Division 2, Site Work.

ff. CURB REMOVAL AND REPLACEMENT shall be measured and paid for at the contract unit price per foot as specified in the Special Provisions for Civil Items.

gg. HOT-MIX ASPHALT SURFACE REMOVAL, VARIABLE DEPTH shall be measured and paid for at the contract unit price per square yard as specified in the Special Provisions for Civil Items.

hh. CLASS D PATCHES, TYPE IV, 12 INCH (SPECIAL) shall be measured and paid for at the contract unit price per square yard as specified in the Special Provisions for Civil Items.

ii. STORM SEWERS TO BE CLEANED, of the diameter specified shall be measured and paid for at the contract unit price per foot as specified in the Special Provisions for Civil Items.

jj. MANHOLES, TYPE A, 7'-DIAMETER, WITH 2 TYPE 1 FRAME, CLOSED LID, RESTRICTOR PLATE shall be measured and paid for at the contract unit price per each as specified in the Special Provisions for Civil Items.

kk. CATCH BASINS TYPE A 4' DIAMETER WITH SPECIAL FRAME AND GRATE shall be measured and paid for at the contract unit price per each as specified in the Special Provisions for Civil Items.

ll. INLET TYPE A WITH SPECIAL FRAME AND GRATE shall be measured and paid for at the contract unit price per each as specified in the Special Provisions for Civil Items.

mm. CHAIN LINK FENCE REMOVAL shall be measured and paid for at the contract unit price per foot as specified in the Special Provisions for Civil Items.

nn. TRAFFIC CONTROL AND PROTECTION (SPECIAL) shall be measured and paid for at the contract unit price per lump sum as specified in the Special Provisions for Civil Items.

**END OF SECTION 01 01 10**

**DIVISION 2 - SITE WORK**

**SECTION 02 41 00 - DEMOLITION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. The extent and location of the Demolition works shall be as specified herein and as shown in the removal plans. The work includes the requirements for the abandonment, removal, and satisfactory disposal of all materials except materials approved by the ENGINEER to be reused in the work.

**1.2 JOB CONDITIONS**

A. The CONTRACTOR represents that it has visited the site to become familiar with the quantity and character of all materials to be salvaged, abandoned, and demolished. The CONTRACTOR agrees that the premises were made available prior to deadline for submission of Bids for whatever inspection and tests the CONTRACTOR deemed appropriate. The CONTRACTOR assumes full responsibility for the proper disposal of all demolition materials.

B. The Pump Station shall not be decommissioned until the following criteria have been met:

    1. The new Pump Station has been placed in service, and written Notice of Acceptance for the proposed Pump Station from the City of Lake Forest has been provided to the CONTRACTOR,
    2. Salvaged items have been received by IDOT,
    3. Written permission to decommission the existing Pump Station has been permission has been provided to the CONTRACTOR by IDOT.

**1.3 RELATED SECTIONS**

A. Section 01 01 00 – Summary of Work.

B. Section 01 01 10 – Measurement and Payment

**1.4 SUBMITTAL**

A. Submit under provisions of Section 01 01 01 – Summary of Work.

**1.5 BASIS OF PAYMENT**

A. Scope of work shall be as shown and specified in the prospective specifications and divisions, and include, but not limited to, the following major items:

1. All items determined by IDOT that are to be salvaged shall be removed and transported to a site determined by IDOT, by the CONTRACTOR.
2. All equipment that can be removed from the pump station that is not marked for salvage shall be removed and disposed of by the CONTRACTOR.
3. Filling of the Pump Station with lightweight cellular concrete fill to the storage room level as shown in the plans and details.

B. Payment

1. Salvaged items shall be removed from the building and delivered to a location determined by the ENGINEER. All remaining items shall be removed and properly disposed. This work is included in the lump sum pay item, DEMOLITION OF EXISTING PUMP STATION.
2. The work specified under this Section and as required for the backfilling of the below the storage room level portion of the building to remain shall be measured and paid at the contract unit price per cubic yard for the Item, LIGHTWEIGHT CELLULAR CONCRETE FILL.

**PART 2 - PRODUCTS:**

LIGHTWEIGHT CELLULAR CONCRETE FILL shall conform to the Specifications for Lightweight Cellular Concrete Fill.

**PART 3 - EXECUTION:**

**3.1 SALVAGING, REMOVAL, AND DEMOLITION**

A. Salvaging, Removal, and Demolition work to be included under the Item, DEMOLITION OF EXISTING PUMP STATION shall include, but not be limited to, the following:

1. Salvaging of both main pumps.
2. Salvaging of the dry pit heater.
3. Removal and disposal of all electrical equipment (except for lighting of the main and storage levels), communications equipment, wiring, conduit, and HVAC equipment (excluding the dry pit heater).
4. Removal and disposal of the existing piping systems. All pipes, conduits, and any open penetrations to the walls of the pump station shall be plugged.

5. Sealing all existing pipes entering or leaving the pump station.
   a. All inlet and/or outlet connections shall be securely sealed to the satisfaction of the ENGINEER.
6. Removal of the wall separating the storage level from the dry pit.
7. Filling the existing wet and dry pits to the level of the storage room floor, in order to create a large single usable storage area. All electrical equipment and wiring needed to maintain lighting to the storage room and main floor of the pump station shall remain in place and verified to be operational.

**3.2 DISPOSAL**

A. General: All materials, except those indicated to be salvaged, upon their demolition, shall become the property of the CONTRACTOR and shall be removed and promptly disposed of in a lawful manner away from the site.

B. Cleanup: After filling of the pump stations wet and dry pits, clean all of the floors of all debris and dust. There shall be no debris, rubble, or litter left inside the pump station or outside of the bridge abutments from any of the demolition operations, and the site shall be clean.

**END OF SECTION 02 41 00**

**DIVISION 3 - CONCRETE**

**SECTION 03 30 00 - CAST-IN-PLACE CONCRETE**

**GENERAL:**

**DESCRIPTION.**

A. The work shall include requirements for all Cast-In-Place Concrete, as shown and specified herein. The work shall also include requirements for Concrete Form work for structural concrete, Concrete Reinforcement and Concrete Accessories.

B. Unless otherwise indicated, concrete material and work shall be in conformance with the requirements of the Standard Specifications for Road and Bridge Construction, adopted January 1, 2012, a publication of the Illinois Department of Transportation. Refer to Division 1 for additional requirements.

**SUBMITTALS.**

A. Submit under provisions of Section 01 01 00 – SUMMARY OF WORK and Standard Specifications**.**

**QUALITY ASSURANCE.**

A. Under provisions of Standard Specifications.

**BASIS OF PAYMENT.**

A. Measurement

1. The work specified for concrete shall be measured as specified in Article 503.21 of the Standard Specifications.

B. Payment

1. The work specified under this Section excluding concrete reinforcements shall be paid for at the contract unit price per cubic yard for CONCRETE STRUCTURES, which price shall be considered as payment in full for this Item.

2. The work specified under this Section for concrete reinforcements shall be paid for at the contract unit price per pound for REINFORCEMENT BARS, EPOXY COATED, which price shall be considered as payment in full for this item.

**PRODUCTS:**

**CONCRETE FORM WORK.**

A. Forms shall be of wood or metal, as required, and supplied in sufficient quantities so that work can be properly accomplished.

B. Forms shall be constructed to slopes, lines and dimensions shown, plumb, straight and sufficiently tight to prevent leakage and so braced that no distortion or settling can take place during or after placing of concrete.

C. Forms shall conform to the requirements of Section 503 “Concrete Structures” of the Standard Specifications.

**CONCRETE REINFORCING.**

A. General

1. All concrete reinforcement bars, fabric and strand shall meet the requirements of Article 1006.10 of the Standard Specifications.

2. All steel reinforcement bars shall be deformed bars conforming to the requirements of AASHTO M-31, M-42 or M-53 Grade 60 ksi, and the applicable portions of the Standard Specifications. Epoxy coated bars shall conform to the requirement of AASHTO M284. Submit one sample of 12 inch long steel reinforcement bars and one sample each reinforcement accessories. Materials shall meet the requirements of Section 508 and Section 1006 of the Standard Specifications.

3. Reinforcing bars shown to be welded on Drawings shall be Designation ASTM A706, Grade 60.

4. Minimum clearances for reinforcement bars shall be as shown on the Plans. Where clearances are not shown on the Plans, the minimum clearances shall be as specified in ACI-318 (Building Code Requirements for Reinforced Concrete).

**CONCRETE.**

c.General

1. Unless otherwise indicated, all regular concrete shall be Class SI with 14 days Compressive Strength of 3,500 psi Section 1020 of the Standard Specifications. Fly ash shall be stored at the concrete mixing plant separately from the cement. Fly ash and cement shall not be intermixed prior to being added to the concrete mix.

2. Unless otherwise indicated, all cement shall be Portland Cement type I or II.

3. The coarse aggregate gradations for all regular concrete (Class SI) shall be CA7 or CA 11.

4. Concrete Proportions: Concrete proportions shall be selected to provide the required strength and durability and to provide work ability and consistency so that the concrete can be worked into forms and around reinforcement without segregation or excessive bleeding.

   Establish concrete proportions including the water-cementitious material ratio on the basis of field experience or trial mixtures with the materials to be used in accordance with ACI 318.

5. The concrete mix design slumps shall be within the following limits:

   Concrete Placement (Class SI)

   Normal 2 in. to 4 in.
   Pumped 4 in. to 6 in.

B. Fiber Reinforcement Concrete

1. Fiber Reinforcement Manufacturers:

   a. W.R. Grace & Co.
   b. Fibermesh Co.
   c. Euclid Chemical Co.

2. Dosage Rate: 1-1/2 lbs/cu yd min.
3. Use in strict accordance with manufacturer's written recommendation and ASTM C94.

**WATERSTOP.**

A. Virgin polyvinyl chloride (PVC) waterstop conforming to CRD C572, with hog rings or grommets at 12 to 18 in. oc.

B. Construction Joints: Dumbbell or serrated type, 6 in. wide by 3/8 in. thick, at center.

C. Provide prefabricated tees, crosses, and other configurations as required.

D. Gasket Type Waterstop: 1" by ¾" Waterstop-Rx by American Colloid Co. or SikaSwell S-Sealant by Sika Corp.

**MECHANICAL SPLICER.**

A. Develop minimum 125% of yield capacity of bars spliced in tension when tested as assembly in accordance with ASTM A370 and ASTM A615.

**EXECUTION:**

**FORM.**

A. FORM INSTALLATION

1. Form surfaces shall be smooth and free from any imperfections which would cause objectionable roughness on the finished surface of the concrete.

2. All forms for concrete shall be tied with rods or patented ties where the concrete is to be exposed. Ties within the forms shall be constructed so as to permit their removal in accordance with the requirements of Section 503.06 of the Standard Specifications. Ties which are left in place within water containing structures shall be provided with swaged washers or other suitable devices to prevent seepage or moisture along the ties. Use lugs, cones, washers or other devices which do not leave holes or depressions greater than 7/8-inch in diameter.

3. All necessary inserts in form work such as rods, bolts, anchorages, fillets, and other devices shall be installed as required.

4. Forms shall not be treated with material that will adhere to or discolor the concrete.

5. All sheeting, bracing and timbering shall be placed entirely outside of the neat lines of the structure, except that flanges or projections of steel shapes may extend into the concrete a distance not exceeding 2 inches. All sheeting shall be closely fitted to the excavation and no timber shall be left within the finished lines of the structure. The bracing shall be so arranged that no stress will be placed on any part of the sub-structure concrete until the concrete has developed sufficient strength to support safely the load thereon.

6. For all exposed concrete edges a ¾ inch chamfer strip shall be provided.

C. FORM REMOVAL

1. Forms shall be removed in such manner and at such a time as to insure the complete safety of the structure. In no case shall the supporting forms or shoring be removed until the members have acquired sufficient strength to support safely their weight and load thereon. The results of suitable control tests shall be used as evidence that the concrete has attained the required strength.

2. Removal of forms shall conform to Section 503.06 of the Standard Specifications.

**CONCRETE REINFORCING.**

A. REINFORCING INSTALLATION

1. Placing and fastening of reinforcement shall be as per Article 508 of Standard Specifications.

2. The Contractor shall furnish to the Engineer complete bar bending details, bar lists, weights and detail drawings for the fabricating and placing of all reinforcement to be furnished under this contract. Such lists and drawings shall be prepared in accordance with the American Concrete Institute ACI 315, SP66 (Details and Detailing of Concrete Reinforcement), except as otherwise shown on the plans or ordered by the Engineer.

3. Bar bending details, bar lists, weights and detail drawings furnished by the Contractor will be examined by the Engineer and it shall be understood by the Contractor that a responsible amount of time will be necessary for their examination before they can be approved or returned for correction. No reinforcement shall be fabricated until the bar bending details and detail drawings have been approved by the Engineer. The Contractor shall furnish to the Engineer, without extra charge therefore, copies of the approved bar bending details, bar lists and detail drawings in such number as the Engineer may require.

4. Mechanical connections shall develop at least 125 percent of the Specified Yield Strength of the bar in tension.

**CAST-IN-PLACE CONCRETE.**

A. Placing Concrete

1. Concrete placement and consolidation shall comply with provisions of Section 503 of the Standard Specifications.

2. Once concreting is started it shall be carried on as a continuous operation until the placing of the section between construction joints is completed. Sections containing "cold joints" will not be accepted and shall be removed and replaced at the Contractor's expense.

3. Concreting in freezing weather shall comply with the provisions of Section 1020 of the Standard Specifications.

4. Old concrete surfaces that will be in contact with the new concrete shall be coated with an epoxy bonding agent, Sika Chemical Co. Sikadur Ili-Mod (Sikastix 370), or approved equal. Application shall be in strict conformity with the manufacturer's recommendations, with particular attention given to temperature requirements. Applicable provisions of Article 503.09 (a) (2) of the Standard Specifications shall be followed. This work will not be paid for separately, but shall be incidental to the contract unit price for Class SI Concrete, and no additional compensation will be allowed.

5. The concrete surface for Wet Well and Discharge Chamber bottom shall be screeded and wood floated.

6. All interior and exterior surfaces that will be exposed to view after completion of the work shall be given a normal finish in accordance with Section 503.16(a) of the Standard Specifications.

7. All top slab surfaces exposed to the weather shall be finished to a true and even surface with floats and trowels. The final troweling shall be done with a steel trowel, leaving a smooth even surface. After the water sheen has disappeared, the surface shall be given a final finish by brushing with a whitewash brush. The brush shall be drawn across the slab with adjacent strokes slightly overlapping, producing a uniform, slightly roughened surface with parallel brush marks. All edges shall be rounded with an edging tool.

8. Concrete floor slab of building shall have a smooth steel troweled finish and all edges of finished surfaces shall be rounded or leveled with edging tools. The pumping station floor slab shall be treated with an approved floor hardener and sealer.

9. All concrete shall be cured for a minimum of 7 days in accordance with Section 1020.13, "Curing and Protection" of Portland Cement Concrete.

**END OF SECTION 03 30 33**

**DIVISION 3 – CONCRETE**

**SECTION 03 41 13 – PRESTRESSED HOLLOWCORE PLANK**

**GENERAL:**

**DESCRIPTION.**

The Work of this Section includes all labor, materials, equipment and services necessary to complete the precast hollowcore plank as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:
Hollowcore plank.
Grouting between units.

**RELATED WORK.**

**QUALITY ASSURANCE.**

Manufacturer Qualifications: The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute (PCI) Plant Certification Program prior to the start of production. Manufacturer shall be certified in category C3.
The manufacturer shall, at his expense, meet the following requirements:
The basis of inspection shall be the Prestressed Concrete Institute's "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products", MNL-116, and the criteria for acceptance shall be the same as the Plant Certification Program.

Erector Qualifications: PCI Qualified and regularly engaged for at least three years in the erection of precast structural concrete similar to the requirements of this project. Retain a registered structural engineer to certify that erection is in accordance with design requirements.

Welder Qualifications: In accordance with AWS D1.1.

Testing: In general compliance with applicable provisions of Prestressed Concrete Institute MNL-116, "Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products".

Requirements of Regulatory Agencies: All local codes plus the following specifications, standards and codes are a part of these specifications:
ACI 318 – Building Code Requirements for Reinforced Concrete;
AWS D1.1 – Structural Welding Code-Steel;
AWS D1.4 – Structural Welding Code-Reinforcing Steel;
ASTM Specifications – As referred to in Part 2-Products, of this Specification.

**SUBMITTALS AND DESIGN.**

Shop Drawings:
Erection Drawings

Plans locating and defining all hollowcore planks furnished by the manufacturer, with all major openings shown.
Sections and details showing connections, weld plates, edge conditions and support conditions of the hollowcore plank units.
All dead, live and other applicable loads used in the design.
Fire rating.
Estimated Camber:

Production Drawings
Plan view of each hollowcore slab unit type.
Sections and details to indicate quantities, location and type of reinforcing steel and prestressing strands.
Lifting and erection inserts.
Dimensions and finishes.
Prestress for strand and concrete strength.
Camber.

Approvals:
Submit five copies of erection drawings and calculations for approval prior to fabrication. Fabrication not to proceed prior to receipt of approved drawings and calculations.

Product Design Criteria:
Loadings for design
Initial handling and erection stresses.
All dead and live loads as specified herein. (DL = 20 psf, LL = 50 psf)
All other loads specified for hollowcore plank where applicable. Reference Mechanical supply and exhaust fans in the construction documents.
Design steel plank support headers when such headers are determined necessary by the manufacturer's engineer.
Design calculations shall be performed by an engineer, registered in the state that the project is located in, and experienced in precast prestressed concrete design. Design calculations to be submitted for approval upon request.
Design shall be in accordance with ACI 318 and applicable codes.

Permissible Design Deviations:
Design deviations will be permitted only after the Architect/Engineer’s written approval of the manufacturer’s proposed design supported by complete design calculations and drawings.
Design deviations shall provide an installation equivalent to the basic intent without incurring additional cost to the owner.

Test Reports: Test reports on concrete and other materials shall be submitted upon request.

**SAFETY.**

The Contractor shall provide and maintain all safety barricades, rebar caps and opening covers required for plank in accordance with current industry safety standards.

**PRODUCT DELIVERY, STORAGE AND HANDLING.**

Delivery and Handling:

Hollowcore plank shall be lifted and supported during manufacturing, stockpiling, transporting and erection operations only at the lifting or supporting points, or both, and with approved lifting devices. Lifting inserts shall have a minimum safety factor of 4. Exterior lifting hardware shall have a minimum safety factor of 5.

Transportation, site handling and erection shall be performed with acceptable equipment and methods and by qualified personnel.

Storage:

Store all units off ground on firm, level surfaces with dunnage placed at bearing points.
Place stored units so that identification marks are discernible.
Separate stacked units by dunnage across full width of each plank.

**BASIS OF PAYMENT.**

The work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for the work described herein.

**PRODUCTS:**

**MATERIALS.**

Portland Cement

ASTM C150 – Type I or III.

Admixtures

Air Entraining Admixtures, ASTM C260, Water Reducing, Retarding, Accelerating, High-Range Water Reducing Admixtures: ASTM C494.

Aggregates

ASTM C33 or C330.

Water

Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

Reinforcing Steel

Bars:

Deformed Billet Steel: ASTM A615.
Deformed Low Alloy Steel: ASTM A706.

Wire:

Cold Drawn Steel: ASTM A82.

Prestressing Strand:

Uncoated, 7-Wire, Low Lax strand: ASTM A416 (including supplement) – Grade 270K.

Structural Steel Plates and Shapes: ASTM A36.

Grout:

Grout shall be a mixture of not less than one part Portland cement to three parts fine sand, and the consistency shall be such that joints can be completely filled but without seepage over adjacent surfaces. The grout shall achieve a minimum 28-day compressive strength of 2,000 psi. Any grout that seeps from the joint shall be completely removed before it hardens.

Bearing Strips: Hardboard.

**CONCRETE MIXES.**

28-day compressive strength: Minimum of 5,000 p.s.i.

Release strength: Minimum of 3,000 p.s.i.

Use of calcium chloride, or admixtures containing chlorides is not permitted.

**MANUFACTURE.**

Hollowcore plank shall be machine cast in 48-inch widths as manufactured by High Concrete Group LLC or equivalent.(Additional sizes as indicated on Drawings)

Manufacturing procedures and tolerances shall be in general compliance with PCI MNL-116.

Openings: Manufacturer shall provide for rectangular openings 12 inches or larger on all sides and as clearly shown on the architectural and structural drawings. They shall be located by the trade requiring them and then field cut. Round and small openings (less than 12 inches) shall be drilled or cut by the respective trades after grouting. Openings requiring cutting of prestressing strand shall be approved by the precast plank manufacturer before drilling or cutting.

Finishes: Bottom surface shall be flat and uniform as resulting from an extrusion process, without major chips, spalls and imperfections. Top surface shall be machine formed.

Patching: Will be acceptable providing the structural adequacy of the hollow core unit is not impaired.

**EXECUTION:**

**ERECTION.**

Site Access: Erection access suitable for cranes and trucks to move unassisted from public roads to all crane working areas as required by erector, or otherwise indicated herein, will be provided and maintained by the general contractor.

Preparation: The general contractor shall be responsible for:

Providing true, level, bearing surfaces on all field-placed bearing walls and other field-placed supporting members. Masonry wall bearing surfaces shall be bond beams with properly filled concrete of adequate strength.

All pipes, stacks, conduits and other such items shall be stubbed off at a level lower than the bearing plane until after the plank are set. Masonry, concrete or steel shall not be installed above plank-bearing surface until after the plank is in place and grout reaches adequate strength.

Installation: Installation of hollowcore plank shall be performed by the manufacturer or a competent erector. Members shall be lifted with slings at points determined by the manufacturer. Bearing strips shall be set where required. Grout keys shall be filled. Openings shall be field cut only after grout has reached adequate strength, unless authorized by the manufacturer's engineer. The general contractor is to provide temporary shoring or bracing of framing to accept hollowcore plank prior to plank being set.

Snow Removal: Snow removal and winter heat will be provided by the general contractor.

Alignment: Members shall be properly aligned. Variations between adjacent members shall be reasonably leveled out by jacking, bolting or any other feasible method as recommended by the manufacturer.

**FIELD WELDING.**

Field welding is to be done by qualified welders using equipment and materials compatible to the base material.

**ATTACHMENTS AND OPENINGS.**

Attachments: Subject to approval of the Architect/Engineer, hollowcore plank units may be drilled or "shot" provided no contact is made with the prestressing steel. Should spalling occur, it shall be repaired by the trade doing the drilling, shooting or cutting. Holes shall be drilled by the general contractor.

Openings: Any unframed opening shall be drilled or cut by the respective trades without making contact with prestressing strand.

**WEEP HOLES.**

Quarter-inch holes shall be drilled into the bottom of each core at each end of hollowcore plank to allow drainage of accumulated moisture. Holes shall be drilled and patched by the general contractor.

**CLEAN UP.**

Remove rubbish and debris resulting from hollowcore plank work from premises upon completion.

**END OF SECTION 03 41 13**

**DIVISION 3 - CONCRETE**

**SECTION 03 60 00 - GROUT**

**PART 1 - GENERAL:**

**1.1 SECTION INCLUDES.**

A. Grout for equipment bases.

B. Grout for pipe and conduit penetrations.

C. Grout for anchor bolts.

D. Grout for slide gate frame.

**1.2 RELATED SECTIONS.**

A. Section 03 30 00 - Cast-In-Place Concrete.

B. Section 05 05 23 – Bolts, Anchor Bolts, Concrete Anchors, and Concrete Inserts.

C. Section 33 40 10 – Interior Pipe and Appurtenances.

**1.3 REFERENCES.**

A. ASTM C109 - Compressive Strength of Hydraulic Cement Mortars (using 2" or 50 mm. Cube Specimens).

B. ASTM C150 - Portland Cement.

C. ASTM C191 - Time of Setting of Hydraulic Cement by Vicat Needle.

D. ASTM C827 - Early Volume Change of Cementitious Mixtures.

E. CRD-C-588 - Specifications for Non-Shrink Grout.

F. CRD-C-619 - Specification for Grout Fluidifier.

G. CRD-C-621 - Specification for Non-Shrink Grout.

**1.4 SUBMITTALS.**

A. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.

B. Submit manufacturer's installation instructions under provisions of Division 1.

**1.5 TESTS.**

A. Testing of grout will be performed under provisions of Division 1.

**1.6 DELIVERY, STORAGE AND HANDLING.**

A. Grout materials from manufacturers shall be delivered in unopened containers.

B. Maintain packaged materials clean, dry and protected against dampness, freezing and foreign matter.

**1.7 ENVIRONMENTAL REQUIREMENTS.**

A. Maintain materials and surrounding air temperatures to a minimum of 50°F prior to, during and 48 hours after completion of the Work.

B. If manufacturer's requirements are more stringent, such requirements shall govern.

**1.8 BASIS OF PAYMENT.**

A. The work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for the work described herein.

**PART 2 - PRODUCTS:**

**2.1 MATERIALS.**

A. Each required material shall have one manufacturer throughout the use of that material on the Work.

**2.2 MANUFACTURERS - NON-SHRINK, NON-METALLIC, 100% SOLID, HIGH STRENGTH EPOXY GROUT.**

A. Sikadur 42, Grout-Pak by Sika Chemical Company.

B. Five Star Epoxy Grout by U.S. Grout Corporation.

C. Substitutions: Under provisions of Division 1.

**2.3 MATERIALS- NON-SHRINK, NON-METALLIC, CEMENTITIOUS GROUT.**

A. Pre-mixed, non-staining, cementitious grout requiring only the addition of water at the job site; conforming to the following:

1. Non-shrink: No shrinkage (0.0%) and a maximum of 0.2% expansion in the hardened state when tested in accordance with CRD-C-621.

2. Compressive Strength: A minimum 28-day compressive strength of 7,000 psi when tested in accordance with ASTM C109.

3. Setting Time: A minimum initial set time of 60 minutes when tested in accordance with ASTM C191.

4. Composition: Shall not contain metallic, particles, chlorides or expansive cement.

**2.4 MANUFACTURERS - NON-SHRINK, NON-METALLIC, CEMENTITIOUS GROUT.**

A. Sika Grout 212 by Sika Chemical Company.

B. Masterflow 928 by Master Builders Company.

C. Sealtight 588 grout by W. R. Meadows, Inc.

D. Substitutions: Under provisions of Division 1.

**2.5 MATERIALS - CEMENT-SAND GROUT.**

A. Use 1 part cement to 3 parts sand. Keep the water cement ratio below 0.45 and achieve a minimum 28-day compressive strength of 4,000 psi.

B. Cement: ASTM C150, Type 2.

C. Sand: ASTM C33.

D. Water: Clean, fresh, potable water free from injurious amounts of vegetable matter and mineral salts.

## PART 3 - EXECUTION:

**3.1 INSPECTION.**

A. Examine site for unsatisfactory conditions or deficiencies that have been corrected under which grout is to be installed and notify Engineer in writing.

**3.2 INSTALLATION.**

A. Place grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications, do not proceed until Engineer provides clarification.

B. Drypacking for vertical grouting behind vertical base plates.

C. Manufacturers of proprietary products shall make available upon 72 hours' notification the services of a qualified, full-time employee to aid in assuring proper use of the product under job conditions.

D. Placing grout shall conform to temperature and weather limitations in Section 3A.

E. Equipment Bases

1. After shimming all equipment to proper grade, securely tighten anchor bolts. Properly form around the base plates allowing sufficient room around the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with grout. Use non-metallic cementitious grout unless another type of grout is recommended by equipment manufacturer.

2. Non-shrink, non-metallic epoxy grout may be used with Engineer's specific review.

## 3.3 SCHEDULE.

A. Non-Shrink, Non-Metallic Cementitious Grout: anchor bolts, equipment bases, pipe supports, pipe and conduit penetration, slide gate frame, and pipe thrust support structures.

B. Cement-Sand Grout: Pipe and conduit penetrations for non-water containing structure, and repair of exposed concrete.

**END OF SECTION 03 60 00**

**DIVISION 4 - MASONRY SYSTEM**

**SECTION 04 10 00 - UNIT MASONRY**

**GENERAL:**

**DESCRIPTION.**

The scope of work under this Division shall include the furnishing and installing of all masonry units, bond beams, grout and mortar, reinforcing steel, wall ties, flashing, and appurtenant work required to complete the masonry walls and partitions as shown on the Drawings and as specified herein. Refer to Division 1 for additional requirements.

The Contractor shall be responsible for ascertaining the extent of work by other trades which require coordination with this work and shall be responsible for the coordination thereof.

This work shall include the setting and incorporating into the masonry of all bolts, anchors, inserts, nailers, metal attachments, etc. as indicated on the Drawings, as specified herein, as furnished by others, and as located by others.

This work shall include the building in of all door and window frames, vents, louvers, conduits, pipes, etc. as shown on the Drawings and as furnished by and set by others.

**RELATED WORK.**

Section 03 30 00 – Cast-In-Place Concrete.

Section 05 10 00 – Structural Steel.

Section 05 50 00 – Metal Fabrications.

Section 05 05 23 – Bolts, Anchor Bolts, Concrete Anchors, And Concrete Inserts

Section 06 10 00 – Carpentry.

Section 07 41 13 – Metal Roof Panels.

Section 07 62 00 – Sheet Metal Flashing and Trim.

Section 07 92 00 – Joint Sealers.

Section 07 20 00 – Board Insulation.

Section 08 13 19 – Stainless Steel Doors and Frames.

Section 08 71 00 – Door Hardware.

Section 09 10 00 – Painting

Section 10 00 00 – Specialties.

Divisions 11, 12, 13 & 15.

**REFERENCE STANDARDS.**

This work is subject to the requirements of the applicable portions of the following standards:

General:

ACI 530: Building Code Requirements for Concrete Masonry Structures.
ACI 530.1: Specifications for Masonry Structures.
IBC 2006: International Building Code.

Mortar:

ASTM C5: Quicklime for Structural Purposes.
ASTM C144: Aggregate for Masonry Mortar.
ASTM C150: Portland Cement.
ASTM C207: Hydrated Lime for Masonry Purposes.
ASTM C270: Mortar for Unit Masonry.
ASTM C404: Aggregates for Masonry Grout.
ASTM C476: Grout for Masonry.
ASTM C780: Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
ASTM C1019: Method of Sampling and Testing Grout.

Unit Masonry:

ASTM A123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A525: Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process.
ASTM B370: Copper Sheet and Strip for Building Construction.
ASTM C90: Hollow Load Bearing Concrete Masonry Units.
ASTM C216: Facing Brick (Solid Masonry Units Made From Clay or Shale).

**SUBMITTALS.**

Samples of glass block, brick and block per the type, size, color and texture shall be submitted. As a minimum, samples shall include 3 blocks of the following:

Glass Block.
Glazed single face block.
Glazed double face block.
Brick unit.
Concrete masonry unit.

Material submittals shall include manufacturer's certification of compliance for the type and grade of masonry units supplied.

Include design mix, indicate proportion or property method used, required environmental conditions, and admixture limitations.

Submit test reports on mortar indicating conformance with ASTM C270.

Submit test reports on grout indicating conformance with ASTM C476 and C1019.

Submit manufacturer's certificate indicating that products meet or exceed specified requirements.

**DELIVERY AND STORAGE.**

Deliver cements and lime to the site in unopened containers. Use one manufacturer's product for each type of material throughout the work. Do not use material that has, in the opinion of the Engineer, become unstable for good construction.

Store cementitious materials off the ground and completely cover with a wind safe waterproof covering.

Take special precautions during transit and storage of masonry units to protect them from staining or discoloration from any cause whatsoever and replace permanently discolored units, whether set in place or not. Stains which cannot be removed with clean water and fiber brushes shall be considered defects and pieces so stained shall not be used.

Stack masonry units on platforms and cover, or store in other approved manner that will protect them from contact with soil and from weather exposure.

**ENVIRONMENTAL REQUIREMENTS.**

Maintain materials and surrounding air temperatures to minimum 50 degrees F (10 degrees C) prior to, during, and 48 hours after completion of masonry work.

**MIX TESTS.**

Testing of Mortar Mix: In accordance with ASTM C780.

Test mortar mix for compressive strength, slump, consistency, mortar aggregate ratio, water content, air content and splitting tensile strength.

Testing of Grout Mix: In accordance with ASTM C1019.

**FIELD MEASUREMENTS.**

Verify that field measurements are as indicated on the Drawings.

**BASIS OF PAYMENT.**

The work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for the work described herein.

**PRODUCTS**

**BRICK UNITS.**

Manufacturers:

1. Belden.
2. Darlington, A General Shale Company.
3. Hanley Brick, A Glen-Gery Brick Company.
4. Substitutions: Approved equal.

A. Brick masonry units shall be face brick in accordance with ASTM C216, Type FBS, Grade SW (severe weathering/exposure), zero efflorescence.

B. Brick masonry units shall be nominal standard size of 4”x2 2/3”x8”. Provide special solid brick units for corners, lintels, headers, bases and other special conditions as required.

C. Color shall be as selected by Owner from manufacturers standard products. Contractor shall submit the sample brick for Engineer’s approval. Do not start Work until Engineer/Owner has accepted sample. The Owner or Engineer’s brick chosen shall be provided by the Contractor at no additional cost to Owner.

**2.2 CONCRETE BLOCK (STANDARD AND GLAZED TYPE CMU).**

A. Manufacturers: Each type of masonry unit shall have a single source of supply through completion of the Work. Substitutions will not be allowed without written approval of the Engineer.

B. Glazed concrete masonry units shall be subject to requirements, provide factory glazed concrete masonry units from one of the followings or approved equal.

1. The Spectra Group, Spectra glazed II CMU.
2. Trenwyth, Astra-glazed CMU.

C. Hollow normal weight concrete block units shall conform to ASTM C 90.

D. Solid normal weight concrete block units shall conform to ASTM C 90.

E. Provide special units for 90 degree corners, bond beams, lintels, jambs, bullnose, wall base (cove-type), and other special conditions as required.

F. Glazed face block color shall be as follows (based on Trenwyth Astra-glazed CMU):

1. Base: As selected by Owner from manufacturers standard products.
2. Walls: As selected by Owner from manufacturers standard products.

3. Contractor shall submit the sample block for Engineer’s approval. Do not start Work until Engineer/Owner has accepted sample. The Owner or Engineer’s block chosen shall be provided by the Contractor at no additional cost to Owner.

G. Glazed face block shall be provided in (1) single glazed face and (2) double glazed face units at locations indicated on drawings.

## 2.3 GLASS BLOCK.

Manufacturers:

1. Seves
2. Approved equal

A. The glass block shall be solid, transparent blocks with smooth outer faces made by fusing together two solid slabs of clear, colorless glass with manufacturer's standard coating factory-applied on edge surfaces. Size shall be 3 inch thick by 7-3/4 inch square actual size.

B. Accessories: Panel reinforcing shall be formed of two parallel wires with cross wires at regular intervals. Expansion strips shall be dense glass fiber matting 3/8" thick x 3" wide. Asphalt emulsion shall be water based.

C. Aluminum angles, plates and tube sections are to be provided with an anodic R1-A1 finish. Interior and exterior color to be selected by Engineer.

## 2.4 MORTAR.

A. Materials:

1. Portland Cement: ASTM C150, Type I, as selected by Owner from manufacturers standard products.
2. Masonry Cement: Not permitted for use.
3. Mortar Aggregate: ASTM C144, standard masonry type. Grading and color suitable for type of masonry, one source for entire project.
4. Hydrated Lime: ASTM C207. Type S
5. Quicklime: ASTM C5, non-hydraulic type.
6. Grout Aggregate: ASTM C404
7. Grout Fine Aggregate: Sand, 50 percent by volume.
8. Water: Clean and potable.

B. Pre-Mix Mortar:

1. Ready mix mortar may be used on this project per the following mortar type listed below:

a. Ready Mixed Mortar for all load bearing and non-loading bearing walls and partitions: ASTM C1142, Type RS with an average compressive strength of 1800 psi at 28 day strength.

C. Mortar Mixes:

1. Mortar for Load, Non-Load Bearing Walls and Partitions, and Reinforced Masonry: Mortar shall be Type S and shall conform to ASTM C 270, with a minimum compressive strength of 1800 psi utilizing the Proportion Method.

2. Pointing Mortar: Mortar shall be Type N and shall conform to ASTM C270, using the Property Method.

3. The mortar shall have proportions of 1 part Portland cement, 1/2 part hydrated lime and 4 parts sand by volume. A measuring box shall be used to attain the specified mix. Sand shall be measured in a loose, damp condition.

4. Mortar shall be freshly prepared and uniformly mixed and shall be of spreadable, workable consistency.

5. The mortar shall be re-tempered with water as required to maintain high plasticity. Re-tempering on mortar boards shall be done only by adding water within a basin formed with the mortar and the mortar worked into the water. Any mortar which has stiffened or which is unused after one and one-half hours from the initial mixing shall not be used.

6. The mortar ingredients shall be mixed in a batch mixer for not less than three minutes.

7. The use of fire clay, rock dust, dirt and other deleterious materials is prohibited.

**2.5 GROUT.**

A. Grout shall conform to ASTM C476 and shall have a minimum strength of 3,000 psi at 28 days.

B. Grout shall have proportions of 1 part Portland cement 0.10 parts hydrated lime and 3 parts sand by volume.

C. Bond Beams: Lintels: 3000 psi strength at 28 days, 7-8 inches slump, mixed in accordance with ASTM C476 Course Grout.

D. Engineered Masonry: 3000 psi strength at 28 days, 7-8 inches slump, mixed in accordance with ASTM C476 Course Grout.

**2.6 CEMENT.**

A. Cement shall be Type 1 Portland cement conforming to ASTM C150. Plastic cement shall not be used.

**2.7 LIME.**

A. Hydrated lime shall conform to ASTM C207.

**2.8 AGGREGATES.**

A. All aggregate for mortar and grout shall be sharp, clean, and well graded and free of injurious amounts of dust, lumps, shale, alkali, surface coatings and organic matter.

B. Aggregate for mortar shall conform to ASTM C144.

C. Aggregate for grout shall conform to ASTM C404 Size No. 2.

## 2.9 WATER.

A. Water shall be free of deleterious quantities of acids, alkalis and organic materials and shall come from a domestic supply.

## 2.10 REINFORCING STEEL.

A. Steel reinforcement bars shall conform to the requirements of ASTM A706 Grade 60 Ksi, deformed and epoxy coated reinforcement bars, and the applicable requirements of Illinois Standard Specifications for Road and Bridge Construction.

B. Reinforcement shall be clean and free from loose rust, scale, dirt, and any coatings that reduce bond.

C. Mechanical splice anchors for reinforcing bars: submit product data and information for review.

## 2.11 HORIZONTAL JOINT REINFORCEMENT AND METAL ACCESSORIES.

A. Wire for joint reinforcement shall be truss type, with moisture drip, hot dip galvanized after fabrication, cold-drawn steel and shall conform to ASTM A82 and ASTM A153, Class B2. As a minimum, longitudinal wires shall be 3/16" side rods with gage cross ties.

B. Manufacturer - Subject to compliance with requirements, provide horizontal joint reinforcement of one of the following, or an approved equal:

1. A. A. Wire Products Co.
2. “Dur-O-Wall” by Dayton Superior
3. Blok-Lok, A Hohmann and Bernard Company

C. Horizontal Joint Reinforcement and Metal Accessories shall be as follows:

1. The width of the horizontal reinforcing shall be 2 inches less than the actual thickness of the wall or partition in which it is to be placed. Splicing of horizontal reinforcing, including corner and partition rein-forcing, shall be done by providing a 8-inch overlapping of side rods.
2. Corners shall be reinforced with Blok-Trus Corner-Lok, standard 9-gauge (0.148") S/R by 9-gauge (0.148") C/R. Intersection between walls and partitions shall be reinforced horizontally with Blok-Trus Partition-Lok, standard 9-gauge (0.148") S/R by 9-gauge (0.148") C/R, or equal, spaced at 16-inch centers vertically, in the same course as the wall reinforcing.
3. Solid and hollow interior or exterior masonry walls shall be reinforced horizontally with Blok-Trus AA600, (AA610) Standard 9-gauge (0.148") S/R by 9-gauge (0.148") C/R or equal, spaced at 16-inch centers vertically.

## 2.12 FLASHING.

A. Rubberized asphalt sheet flashing with metal drip edge.

B. Sheet Flashing:

1. “Perm-A-Barrier VP” as manufactured by W. R. Grace & Co.
2. “Dur-O-Barrier” as manufactured by Dayton Superior.
3. A self-sealing, self-healing, fully adhered composite flexible, self-adhesive, cold applied sheet consisting of a minimum of 32 mils of rubberized asphalt bonded to an 8 mil high density cross laminated polyethylene film.
4. Metal drip edge shall be 26 gauge 304 stainless steel sheet. Drip edge shall be minimum 2 ½ inches wide with 5/8 inch 135 degree drip and minimum ¼ inch hem along outside edge.
5. Accessories: Primer, conditioner, adhesive, and mastic compatible with the sheet flashing as recommended by the sheet flashing manufacturer.

## 2.13 ACCESSORIES.

A. Cleaning Solutions: Non-acidic, not harmful to masonry work or adjacent materials per the following:

1. Cleaners for red and light colored brick not subject to metallic staining with mortar not subject to bleaching.

   a. Sure Klean No. 600 Detergent; ProSoCo. Inc.
   b. Approved equal.

2. Cleaners for brick subject to metallic staining:

   a. Sure Klean Vana Trol; ProSoCo. Inc.
   b. 202V Vana-Stop; Diedrich Technologies, Inc.
   c. Approved equal.

3. Cleaners for glazed concrete masonry units

   a. Cleaning solution as recommended by glazed block manufacturer. Submit cleaning solution and manufacturer’s instructions and recommends for review.

B. Cavity Drainage Material: 1 inch thick, free draining mesh; made from polyethylene, polypropylene, or other polymer strands and shaped to avoid being clogged by mortar droppings per the following:

1. Mortar Break; Advanced Building Products, Inc.
2. Mortar Net; Mortar Net U.S.A. Ltd.

C. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142 inch steel wire, hot-dip galvanized after fabrication.

## 2.14 DOVETAIL ANCHOR SLOTS AND ANCHORS.

A. 20 gauge galvanized dovetail foam filled anchor slots compatible with anchors.

B. 16 gauge by 1 in. galvanized corrugated, dovetailed metal anchor straps.

C. Zinc coated in accordance with ASTM A153, Class B2.

## 2.15 WEEPHOLE MATERIAL.

A. 1/4 in. dia. plastic or rubber tube.

B. Cotton sash cord.

## PART 3 - EXECUTION

## 3.1 GENERAL.

A. Masonry work shall not be started when the horizontal and vertical alignment of the foundation is out of plumb or line.

B. Masonry The top surface of the concrete foundation shall be clean and free of laitance and the aggregate exposed before starting the masonry.

C. All masonry shall be laid true, level and plumb in accordance with the Drawings.

D. Proper masonry units shall be used to provide for all windows, doors, vents, bond beams, lintels, etc. as shown on the Drawings or otherwise required to provide a minimum of unit cutting.

E. Where masonry unit cutting is necessary, all cuts shall be neat and true and made by a masonry saw. Openings for other trades shall be neatly patched.

F. Unless otherwise indicated, the masonry units shall be laid in a running bond pattern. All bond patterns and special details shown on the drawings shall be accurately and uniformly executed.

G. All masonry units shall be sound, free of cracks or other defects that would interfere with the proper placing of the unit or impair the strength of construction.

H. The starting joint on foundations shall be laid with full mortar coverage on the bed joints, except that area where the grout occurs shall be free from mortar, so that the grout will be in contact with the foundation. The starter coarse shall be laid out dry to determine the extent to which they must be cut, or joint sizes varied, to accomplish accurate horizontal coursing.

I. Mortar joints shall be straight, clean, and uniform in thickness and shall be tooled joints. Unless otherwise indicated, both horizontal and vertical masonry joints shall be 3/8-inch nominal thickness.

J. Unless otherwise indicated, all face joints shall be tooled to provide a concave joint. Tooling shall be done when the mortar is partially set and still sufficiently plastic to bond. The tooling shall be done in a matter to provide strength and weather resistance. Unless otherwise indicated all concrete block joints shall be tooled. Where tooled joints are not possible, the joints shall be troweled flush.

K. Care shall be taken to prevent visible mortar and grout stains on all sides that will be exposed to view. In general, the walls shall be kept continually clean. Grout run over shall be cleaned immediately.

L. All surfaces, including sills, ledges, finished concrete, etc., shall be protected from mortar droppings or other damage during construction.

M. Horizontal reinforcing shall be laid on the webs of bond beam units.

N. Wire reinforcement shall be completely embedded in mortar or grout. Mortar joints with wire reinforcement shall be at least twice the thickness of the wire.

O. Install horizontal joint reinforcement 16 inches o.c. Place joint reinforcement in first horizontal joints above and below openings. Extend minimum 16 inches each side of opening. Place joint reinforcement continuous in first joint below top of walls.

P. As a minimum, wire reinforcement shall be lapped 8 inches at splices and shall contain at least one cross wire of each piece of reinforcement in the lap distance.

Q. Reinforcement shall be in place before grouting starts. The grouting space shall be free from mortar droppings. All grout shall be puddled or vibrated in place.

R. Grouting at beams over openings shall be done in one continuous operation.

S. All cells containing reinforcement, anchor bolts, inserts, etc. shall be grouted solidly. Spaces around metal door frames and other built-in items shall be filled solidly with grout.

T. Beams and other structural members shall be anchored to the wall with anchor bolts or their equivalent. Anchors shall be fully, solidly embedded in place. Embedment shall not be less than 2/3 of wall thickness unless otherwise noted. Bearing pads shall be furnished below beams to prevent spalling of the masonry, if required.

U. Masonry shall not be erected when the ambient temperature is below 0 degrees C (32 degrees F) with a rising temperature, or below 4 degrees C (40 degrees F) with a falling temperature, or when there is a probability of such a condition existing within 48 hours, unless special provisions are made for heating the materials and protecting the work from freezing. Protection
shall consist of heating and maintaining the temperature of the masonry materials at not less than 4 degrees C (40 degrees F) but not more than 71 degrees C (160 degrees F), and maintaining an air temperature above 4 degrees C (40 degrees F) on both sides of the masonry for not less than 72 hours. Work will not be permitted with or on frozen materials. Masonry work which has frozen before the mortar has set shall be removed and replaced. No brick or other units having a film of frost on their surfaces shall be laid in the walls.

V. One section of the walls shall not be carried up in advance of the others, unless specifically approved. Heights of masonry shall be checked with an instrument at each floor, and at sills and heads of openings, to maintain the level of the walls. Partitions shall extend from the floor to the bottom of the floor or roof construction above, unless otherwise indicated. Walls and partitions shall be structurally bonded or anchored to each other and to concrete walls, beams and columns. Non load-bearing partitions and interior walls shall be securely anchored to the construction above and in a manner that provides lateral stability.

W. Unfinished work shall be stepped back for jointing with new work; toothing will not be permitted, except where specified. All loose mortar shall be removed and the exposed jointing thoroughly wetted for not less than 12 hours before laying new work.

X. Surfaces of masonry not being worked on shall be properly protected at all times during the construction operation. When rain or snow is imminent and the work is discontinued, the tops of exposed masonry walls and similar surfaces shall be covered with a strong waterproof membrane, well secured in place.

Y. Concrete masonry units shall be cut and fit for placement of monorail and support beam. Coordinate with other sections of work to provide correct size, shape, and location.

## 3.2 CAVITY WALL CONSTRUCTION.

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep.

B. Build inner wythe ahead of outer wythe to receive cavity insulation and air/vapor barrier sheet/adhesive.

## 3.3 CONCRETE MASONRY UNITS

A. All concrete masonry units shall be true, plumb and built to the thickness and bond pattern indicated. Special units shall be furnished and used where indicated and as specified. Cutting of units shall be avoided insofar as possible. Cutting at the site shall be done with a power-driven carborundum saw. Units shall not be wetted prior to use.

B. The first course of concrete masonry units shall be laid in a full bed of mortar for the full width of the unit. Bed joints of a concrete masonry unit shall be formed by applying the mortar to the entire top surfaces of the inner and outer face shells, and the head joints shall be formed by applying the mortar for a width of about 1 inch to the ends of the adjoining units laid previously. Mortar for joints shall be smooth, not furrowed, and of such thickness that it will be forced out of the joints as the units are being placed in position. Where anchors, bolts, reinforcing and ties occur within the cells of the units, such cells shall be filled with mortar or grout as the work progresses. Concrete brick shall be used for topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as indicated.

C. Concrete masonry lintels shall be installed over openings where steel or precast concrete lintels are not scheduled. Place reinforcing bars 1 inch from bottom web. Use single piece reinforcing bars only; do not splice reinforcing bars. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position. Place and consolidate grout fill without displacing reinforcing. Grout minimum 2 courses solid (16 inches high) or higher as shown on Contract Drawings. Allow masonry lintels to attain specified strength before removing temporary supports. Refer to the following bond beam lintel schedule below:

1. Openings up to 42 inches wide: Place two (2) No. 5 bars 1 inch from bottom web.

2. Openings from 42 inches up to 78 inches wide: Place two (2) No. 5 bars 1 inch from bottom web.

3. Openings over 78 inches wide: Reinforce openings as detailed.

D. Grouted Components (general)

1. Reinforce bond beam (where required and as indicated on drawings) with two (2) No. 5 bars, placed continuous bottom reinforcement.

2. Reinforce other grouted components as shown and indicated on Contract Drawings.

3. Lap splices minimum 40 bar diameters.

4. Support and secure reinforcing bars from displacement. Maintain position within ½ inch of dimensioned position.

5. Place and consolidate grout fill without displacing reinforcing.

6. At bearing locations, fill masonry cores with grout for a minimum 16 inches either side of opening.

E. Control Joints:

1. Do not continue horizontal joint reinforcement through control joints.

2. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3. Size control joint in accordance with Section 7E for sealant performance.

4. Built-In Work

a. As work progresses, build in steel frames at door openings, anchor bolts, embed bearing plates, lintels and other items furnished by other Sections.
b. Build in items plumb and level.
c. Bed anchors of steel frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
d. Do not build in organic materials subject to deterioration.

F. Tolerances

1. Maximum variation from unit to adjacent unit: 1/32 inch.

2. Maximum variation from plane of wall: 1/4 inch in 10 feet, and ½ inch in 20 feet or more.

3. Maximum variation from plumb: 1/4 inch per story non-cumulative; ½ inch in two stories or more.

4. Maximum variation from level coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; ½ inch in 30 feet.

5. Maximum variation of joint thickness: 1/8 inch in 3 feet.

6. Maximum variation from cross sectional thickness of walls: 1/4 inch.

G. Cutting and Fitting

1. Cut and fit for chases, pipes, conduit, sleeves and other components. Coordinate with other Sections of work to provide correct size, shape, and location.

2. Obtain Engineer approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

## 3.4 GLASS BLOCK.

A. Glass block including reinforcing, expansion strips, coatings, anchors and sealants shall be installed in accordance with the manufacturer's recommendations.

B. Clean glass units of substances that may impair bond with mortar or sealant. Coat sill under units with asphalt emulsion as a bond breaker, and allow to dry. Set panel anchors in mortar bed directly over coating. Provide full mortar joints. Furrowing not permitted. Remove excess mortar. Maintain uniform joint width of 3/8 inch.

C. Place panel reinforcement at every second horizontal joint in full mortar bed and at first course above and below openings within the glass unit panel. Discontinue reinforcement at expansion strips.

## 3.5 FLASHING.

A. Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing.

B. Install in accordance with manufacturer’s recommendations to provide continuous flashing system.

C. Provide end dam at each end of flashing to funnel flow out of wall.

D. Turn up sheet flashing a minimum of 8 inches and fully adhere to substrate.

E. Fully adhere sheet flashing to top of metal drip edge and cut off sheet flashing ½ inch back from exterior face.

F. In cold or wet weather when flashing will not fully adhere to substrate, provide termination bar mechanically anchored to substrate at top of flashing to secure flashing in place.

## 3.5 CLEAN-UP.

A. All surplus material and debris shall be removed from the job site when the masonry work is completed. Any items defaced from the masonry work shall be cleaned.

B. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units where intended. Provide new units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

C. After mortar is thoroughly set and cured, remove large mortar particles by hand with wooden paddles and non-metallic scrape holes or chisels.

D. Use bucket and brush hand cleaning method as described in BIA "Technical Note No. 20 Revised" to clean brick masonry made from clay or shale, except use detergent type masonry cleaner.

**END OF SECTION 04 10 00**

**DIVISION 5 - METALS**

**SECTION 05 05 23 - BOLTS, ANCHOR BOLTS, CONCRETE ANCHORS, AND CONCRETE INSERTS**

**PART 1 – GENERAL:**

**1.1 SECTION INCLUDES.**

A. Furnishing and installing all bolts, anchors and inserts, anchor bolts, expansion anchors and concrete inserts for:

1. Piping.
2. Hangers and brackets.
3. Equipment. Electrical, plumbing and HVAC work.
4. Pump base.
5. Miscellaneous fasteners.

**1.2 RELATED SECTIONS.**

A. Section 04 10 00 - Unit Masonry.

B. Section 05 50 00 - Metal Fabrication.

C. Section 33 40 10 – Interior Pipe and Appurtenances.

**1.3 REFERENCES.**

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified.

B. ACI 349 - Appendix B - Code Requirements for Nuclear Safety Related Concrete Structures.

C. AISC - American Institute of Steel Construction, Structural Steel Detailing.

D. ANSI B1.1 - Screw Threads, Coarse Thread Series.

E. ANSI B18.2 - Square and Hex Bolts and Nuts.

F. ASTM A36 - Structural Steel.

G. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

H. ASTM A193 - Alloy-Steel & Stainless Steel Bolting Materials for High-Temperature Service.

I. ASTM A194 - Carbon & Alloy Steel Nuts for Bolts for High Pressure & High Temp. Service.

J. ASTM A242 - High Strength Low-Alloy Structural Steel.

K. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

L. ASTM A325 - Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum tensile Strength.

M. ASTM A354 - Quenched & Tempered Alloy Steel Bolts, Studs & Other Externally Threaded Fasteners.

N. ASTM A563 - Carbon and Alloy Steel Nuts.

O. ASTM A588 - High Strength Low-Alloy Structural Steel With 50 KSI Minimum Yield Point.

P. ASTM B98 - Copper Silicon Alloy Rods, Bars, and Shapes.

Q. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

## 1.4 SUBMITTALS.

A. Samples: Submit for approval the following:

1. Representative samples of bolts, anchors and inserts as may be requested by the Engineer. Review will be for type and finish only. Compliance with all other requirements is exclusive responsibility of Contractor.

B. Shop Drawings: Submit for approval the following:

1. Setting drawings and templates for location and installation of anchorage devices.
2. Copies of manufacturer's specifications, load tables, dimension diagrams and installation instructions for the devices.

C. Contractor shall submit calculations stamped by a professional engineer.

## 1.5 QUALITY ASSURANCE.

A. Bolts, anchor bolts, expansion anchors and concrete inserts shall conform to applicable Section 01 01 00 – SUMMARY OF WORK, METALS, of the Standard Specifications.

## 1.6 BASIS OF PAYMENT.

A. The work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS:

## 2.1 DESIGN CRITERIA.

A. All bolts, studs and nuts shall have American National form right-hand machine cut threads which shall be in conformity with the current ANSI B1.1, "Screw Threads", Coarse Thread Series, Class 2 Fit, unless otherwise specified.

B. Bolt heads and nuts shall be semi-finished and shall be in conformity with ANSI B18.2, "Wrench-head Bolts and Nuts and Wrench Openings", Heavy Series, unless otherwise specified. Nut dimensions shall conform to ANSI Standard B18.2.2 for heavy hex nuts.

C. Allowable tensile design stress for threaded fasteners shall not be greater than 0.33 times minimum tensile strength of threaded fastener on tensile stress area.

D. Concrete Fasteners: When the size, length and load carrying capacity of concrete fasteners is not Specified or shown on the Drawings, provide the size, length and capacity required to satisfy all of the following. Concrete fasteners include anchor bolts, expansion anchors, or concrete inserts:

   1. Working load shall be a minimum of the design load times a safety factor of four, and shall be based on a concrete compressive strength not exceeding 3000 psi.

   2. Shall satisfy all requirements and recommendations of ACI 349, Appendix B.

   3. Shall satisfy all minimum recommendations and requirements of Manufacturer.

   4. Allowances for vibration are not included in the safety factor specified above.

E. Determine design loads as follows:

   1. For equipment anchors, use the design load recommended by the manufacturer and approved by the Engineer.

   2. For pipe hangers and supports, use one half the total weight of pipe, fittings, valves, accessories and water contained in pipe, between the hanger or support in question and adjacent hangers and supports on both sides. Load shall be increased where required to allow for thrust and temperature induced forces.

F. Anchors and inserts shall be located and sized so as not to impair the integrity of the supporting structure.

2.2 MATERIALS

A. Bolts and Anchor Bolts:

   1. Galvanized Steel Bolts and Nuts:

      a. Steel anchor bolts, studs, nuts and washers for interior installation shall be in conformity with the current ASTM Designation: A307 "Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength", Grade B, A36 or approved equal. All steel bolts, studs, nuts and washers shall be hot-dip galvanized in conformance with Class C of ASTM A153. Nuts shall conform to requirements of ASTM A563, heavy hex style.

   2. Stainless Steel Bolts and Nuts:

a. In buried, outdoor, high humidity or submerged locations, provide stainless steel bolts, nuts and washers. Stainless steel bolts and nuts shall be in conformity with the current ASTM A193, Grade B8 (AISI 304) 75 KSI Min. Tensile Strength), Class 1 and ASTM A194, Grade 8 (AISI 304), AISI 316 or approved equal.

b. For high strength applications, stainless steel bolts and nuts shall be in conformity with the current ASTM A193, Grade B8 (AISI 304) (Tensile Strength 100/125 KSI, Class 2 and ASTM A194, Grade 8 Strained Hardened (AISI 304) or approved equal.

3. Bronze Bolts and Nuts:

a. Where shown on Drawings or specified under other Sections, bronze anchor bolts, flange bolts, studs, and nuts shall be in conformity with the current ASTM Designation B98, "Copper-Silicon Alloy Rods, Bars, and Shapes." made of Alloy B12, Hard. Bolts, studs, and nuts machined from bar stock shall be made of Alloy A7, Hard.

4. Other types, if shown on drawings or specified under other Sections.

## 2.3 CONCRETE ANCHORS.

A. Wedge Anchors:

1. Manufacturers:

a. Power-Stud by Powers Fasteners (Rawl).
b. Kwik Bolt II by Hilti Corp.
c. Liebig Wedge Anchor by Liebig.
d. Ankr-Tite Wedge Anchor by Ankr-Tite Fastening Systems.
e. Wedge-All by Simpson Strong-Tie Co., Inc.

2. Usage: In concrete:
a. 316 stainless steel.
b. Do not use when submerged or subjected to dynamic loads.

B. Expansion Anchors:

1. Manufacturers:
a. Power-Bolt by Powers Fasteners (Rawl).
b. HSL Heavy Duty Sleeve Anchor by Hilti Corp.
c. Liebig Anchor by Liebig.

2. Usage: In concrete:
a. 316 stainless steel.
b. Do not use when submerged, in overhead applications, or subjected to dynamic loads.

C. Sleeve Anchors:

1. Manufacturers:
   a. Lok/Bolt by Powers Fasteners (Rawl).
   b. HLC Sleeve Anchor by Hilti Corp.
   c. Sleeve Anchors by Ankr-Tite Fastening Systems.
   d. Sleeve-All Anchor by Simpson Strong-Tie Co., Inc.

2. Usage: In masonry:
   a. 316 stainless steel.

D. Undercut Anchors:

1. Manufacturers:
   a. Maxi-Bolt by Drillco Devices Ltd.
   b. HDA Undercut Anchor by Hilti Corp.
   c. Liebig Ultraplus by Liebig.

2. Usage: In concrete, overhead applications, and for dynamic loads:

   a. 316 stainless steel.
   b. Do not use when submerged.

E. Adhesive Anchors:

1. Manufacturers:
   a. HIT RE 500 Epoxy Adhesive Anchor by Hilti Corp.
   b. AC100 Plus or Power-Fast + by Powers Fasteners (Rawl).
   c. Inject-Tite Two-Part Epoxy by Ankr-Tite Fastening Systems.
   d. ET, SET or ETF Epoxy Adhesive System by Simpson Strong-Tie Co., Inc.

2. Epoxy adhesive with 316 stainless steel stud assembly.
3. Usage:

   a. In concrete, submerged.
   b. In masonry, provide tube screen inserts.
   c. Do not use in overhead applications.

## PART 3 - EXECUTION:

### 3.1 INSPECTION.

A. Examine conditions under which bolts, anchors, or inserts are to be installed, and notify Engineer in writing of unsatisfactory conditions existing.

B. Do not proceed with the Work until unsatisfactory conditions or deficiencies have been corrected in a manner acceptable to Engineer.

### 3.2 INSTALLATION OF EXPANSION ANCHORS AND UNDERCUT ANCHORS.

A. Drilling equipment used and installation of expansion anchors shall be in accordance with manufacturer's instructions.

B. Torque anchor as specified by manufacturer recommendation. Do not cut reinforcing bars.

C. Provide embedded items for placement in concrete form work and assure that embedded items are protected from damage and are not filled in with concrete.

D. Expansion anchors may be used for hanging or supporting pipe 2 inches diameter and smaller.

E. Expansion anchors shall not be used for larger pipe or supporting vibrating equipment unless otherwise shown or approved by the Engineer.

F. Unless otherwise shown, anchor design shall be in accordance with ACI 349, Appendix B and approved by Engineer, and in no case shall be less than:

1. Embedment depth in concrete: 8 diameters.
2. Anchor spacing on centers: 10 diameters.
3. Distance to edge of concrete: 1.5 embedment.
4. Distance to edge of concrete where anchor is loaded in direction of edge: 2.5 embedment.

G. Undercut Anchors shall be installed in accordance with manufacturer's instructions.

## 3.3 CLEANING.

A. After embedding concrete is placed, remove protection and clean bolts and inserts.

**END OF SECTION 05 05 23**

**DIVISION 5 - METALS**

**SECTION 05 10 00 - STRUCTURAL STEEL**

**PART 1 – GENERAL:**

**1.1 SECTION INCLUDES.**

A. Traveling bridge crane beams.

**1.2 RELATED WORK.**

A. Section 03 30 00 - Cast-In-Place Concrete.

B. Section 09 91 00 - Painting.

C. Section 41 22 23 – Hoist Equipment.

**1.3 REFERENCES.**

All reference standards shall be from the latest edition.

A. AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

B. ASTM A36 - Structural Steel.

C. ASTM A123 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.

D. ASTM A325 - High Strength Bolts for Structural Steel Joints.

E. ASTM A 992 – Structural Steel Shapes

F. AWS A2.0 - Standard Welding Symbols.

G. AWS D1.1 - Structural Welding Code.

H. SSPC - Steel Structures Painting Council.

**1.4 DESIGN REQUIREMENTS.**

A. Where final design of members and connections for any portion of the structure is not indicated, perform final design of such members and connections in accordance with AISC Specification and as Specified herein, at no additional cost.

B. Members and connections shall be designed by a structural engineer registered in the State of Illinois.

C. Unless otherwise indicated, design connections in accordance with American Institute of Steel Construction "Manual of Steel Construction, Latest Edition".

## 1.5 SUBMITTALS.

A. Shop Drawings

Indicate profiles, sizes, and locations of structural members, attachments and fasteners.
Indicate welded connections with AWS A2.0 welding symbols.
Indicate net weld lengths and size.
Review of shop drawings in no way affects the Contractor's responsibility for carrying out the Work to Contract Drawings and specifications.
Shop drawings shall be approved prior to fabrication.

B. Manufacturer's Mill Certificate: Submit under provisions of Division 1 certifying that products meet or exceed specified requirements.

C. Welders' Certificates: Submit under provisions of Division 1 Manufacturer's Certificates, certifying welders employed on the Work, verifying AWS qualifications within the previous 12 months in the position in which they will be carrying out the welding.

D. Substitutions of sections or modifications of details and the reasons for these changes shall be submitted by letter with shop drawings for review by the Engineer. Changes in related portions of the Work shall be coordinated by the Contractor.

## 1.6 QUALITY ASSURANCE.

A. Fabricate structural steel members in accordance with AISC-Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

## 1.7 BASIS OF PAYMENT.

A. The work specified under this Section and as required shall be paid for at the Contract unit price per kilogram (pound) for FURNISHING AND ERECTING STRUCTURAL STEEL, which price shall be payment in full
for all labor, materials, tools, equipment and incidentals required to complete this Item.

# PART 2 – PRODUCTS:

## 2.1 MATERIALS.

A. Structural Steel Members: ASTM A36 or A 992.

B. Bolts, Nuts, and Washers: ASTM A325.

C. Welding Materials: AWS D1.1; type required for materials being welded.

D. Materials shall meet the requirements of the Standard Specifications, Section 505.

**2.2 FABRICATION.**

A. Fabricate all members as indicated on Drawings and as outlined in AISC.

B. Perform welding in accordance with AWS D1.1.

C. Fabricating tolerances for finished parts shall comply with AISC Code of Standard Practice.

**2.3 FINISH.**

A. Prepare structural component surfaces in accordance with SSPC-SP6 - Commercial Blast Cleaning.

B. Hot-dip galvanized conforming to ASTM A123 and AHDGA Specifications.

C. Galvanizing repair paint: High zinc-dust content paint complying with MIL-P-21035.

**2.4 SOURCE QUALITY CONTROL AND TESTS.**

A. Testing and analysis of components will be performed under provisions of Division 1.

**PART 3 – EXECUTION:**

**3.1 EXAMINATION.**

A. Verify that field conditions are acceptable and are ready to receive work.

**3.2 ERECTION.**

A. Erect structural steel in compliance with AISC Code of Standard Practice and Specification.

B. Do not field cut or alter structural members without approval of Engineer.

**3.3 FIELD QUALITY CONTROL.**

A. Field inspection will be performed under provisions of Division 1.

**END OF SECTION 05 10 00**

**DIVISION 5 - METALS**

**SECTION 05 50 00 - METAL FABRICATIONS**

**PART 1 – GENERAL:**

**1.1 SECTION INCLUDES.**

A. Provide miscellaneous metal work shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1. Lintels.
2. Metal frames.
3. Attic access hatch.
4. Miscellaneous items.

**1.2 RELATED SECTIONS.**

A. Section 03 30 00 - Cast-In-Place Concrete.
B. Section 04 10 00 - Unit Masonry.
C. Section 05 05 23 - Bolts, Anchor Bolts, Expansion Anchors and Concrete Inserts.
D. Section 09 91 00 - Painting.

**1.3 REFERENCES.**

All reference standards shall be the latest edition.

A. ASTM A36 - Structural Steel.

B. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.

C. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.

D. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A276, Type 316L - Stainless Steel.

F. ASTM A283 - Carbon Steel Plates, Shapes, and Bars.

G. ASTM A325 - High Strength Bolts for Structural Steel Joints.

H. ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.

I. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

J. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

K. ASTM A992 – Structural Steel Shapes.

L. AWS A2.0 - Standard Welding Symbols.

M. AWS D1.1 - Structural Welding Code.

N. AISI - Standard for Stainless Steel.

O. SSPC - Steel Structures Painting Council.

P. ANSI A14.3: Safety requirements for fixed ladders.

Q. Specifications for Aluminum Structures, The Aluminum Association.

## 1.4 SUBMITTALS.

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

B. Submit Product Data.

C. Shop drawings shall be approved prior to fabrication.

D. Indicate all revisions on resubmissions.

## 1.5 QUALITY ASSURANCE.

A. Perform shop and/or field welding required in connection with the work of this Section in strict accordance with pertinent recommendations of the American Welding Society (AWS).

B. Conform to AISC and AA standards.

## 1.6 FIELD MEASUREMENTS.

A. Verify that field measurements are as indicated on shop drawings and in accordance with manufacturers' recommendations.

## 1.7 BASIS OF PAYMENT.

A. The work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for the work described herein.

**PART 2 – PRODUCTS:**

## 2.1 MATERIALS.

A. In fabricating items which will be exposed to view, limit materials to those which are free from surface blemishes, pitting, and roughness.

B. Comply with following standards, as pertinent.

1. Steel plates and shapes: ASTM A36 or A992.

2. Square or rectangular tubing: ASTM A500, Grade B.

3. Round tubing or pipe: ASTM A53, Type E or S, Grade B.

4. Stainless Steel:
   a. Exterior and submerged uses: AISI, Type 316.
   b. Interior uses: AISI, Type 304 or Type 316.

5. Aluminum shapes and plates: Alloy 6061-T6 or 6063-T6.

6. Floor Plate: Stainless steel grate.

7. Connection Bolts:
   a. For steel members: ASTM A325.
   b. For aluminum members: Stainless steel.

8. Cast-in-place Anchor Bolts:
   a. 1/2 in. min dia.
   b. Nonsubmerged: ASTM A307, galvanized.
   c. Submerged: Stainless steel.

9. Malleable Iron: ASTM A47.
   a. Cast Iron: ASTM A48, Class 35B.
   b. Ductile Iron: ASTM A536, Grade 65-45-12.
   c. Cast Aluminum: ASTM B26.

## 2.2 FABRICATION.

A. Except as otherwise shown on the Drawings or the approved Shop Drawings, use materials of size, thickness, and type required to produce reasonable strength and durability in the work of this Section.

B. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

C. Fabricate with accurate angles and surfaces which are true to the required lines and levels, with projecting corners clipped, grinding exposed welds smooth and flush, forming

exposed connections with hairline joints, and using concealed fasteners wherever possible.

D. Weld shop connections and bolt or weld field connections.

E. Use AISC standard 2-angle web connections or single plate framing connections capable of supporting min of 50% of total uniform load capacity of member.

F. Connections shall consist of min two 3/4 in. dia bolts or welds developing min of 10,000 lbs capacity.

G. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish and for the proposed use of the item. Conform to Section 9A.

1. Do not coat ferrous metal surfaces embedded in concrete.
2. Coating of cast iron or ductile iron floor access hatches and pressure relief valves not required.
3. On surfaces inaccessible after assembly or erection, apply two coats of the specified primer.
4. Change color of second coat to distinguish it from the first.
5. Coat aluminum surfaces in contact with concrete with bituminous coating.
6. Under no circumstances shall aluminum contact dissimilar metal.

H. Galvanizing - Galvanize after fabrication.

1. Galvanize by hot-dip process conforming to ASTM A123 and AHDGA specifications.

## 2.3 FINISHES.

A. Prepare structural component surfaces in accordance with SSPC-SP6 - Commercial Blast Cleaning.

B. Shop prime structural steel members except members to be galvanized.
Do not prime surfaces that will be field welded, contact surface for friction bolts, welded studs, deformed bar anchors and steel encased in concrete.

C. Zinc used for hot-dip galvanizing coating shall conform to the Standard Specifications for Slab Zinc (Spelter) ASTM Designation B6 and shall be at least equal to the grade designated as "Prime Western". Thickness of coatings shall conform to ASTM Specifications A123, A153, and A385, as applicable for items coated.

D. Quality of galvanizing shall be rigidly controlled and it shall be understood that any defects as mentioned below shall be just grounds for rejection.

E. Galvanized steel shall have no bare spots unless small and suitable for patching, pimples showing excessive contamination, flux, ash inclusions, or blisters.

F. Where cutting existing galvanized metal work or attaching to existing galvanized metal work, such as by welding, the connection or bore edges shall be cold galvanized.

G. Structural and miscellaneous metal Work shall be galvanized when located on the exterior and on the interior where so indicated and/or specified.

H. Prime paint items in accordance with finish coat requirements.

I. Repair all damage to field-primed surfaces.

## 2.4 LINTELS.

A. Provide steel lintels over openings in masonry walls as noted and wherever reinforced masonry or concrete lintels are not provided.

B. Fabricate lintels from structural steel shapes as detailed, selected for straightness of section, with minimum of 8 in bearing each side of opening.

C. Openings 4 ft and less in width without lintel scheduled shall have double steel angle lintels or reinforced masonry lintels. Total width of horizontal legs shall be 1 in. less than nominal thickness of wall. Weld angles together. Masonry lintels shall conform to requirements of Section 4A.

D. Hot-dip galvanize after fabrication.

## 2.5 METAL FRAMES.

A. Provide door, hatch, grille, louver, and other frames fabricated from structural shapes or plates.

B. Select sections for trueness of web and flange. Straighten members so finished frames are uniform, square, and true throughout length and depth of assembled units.

C. Miter or cope and join members with continuous welds.

D. Provide temporary spreader bars to prevent springing frames out of shape prior to and during erection.

## 2.6 SAFETY GRATE.

A. Where noted on Drawings provide retractable safety grate across access hatch openings.

B. Metal Grating Type:

1. Halliday Retro-Grate.
2. Aluminum construction with safety orange powder coat.
3. Spring loaded lifting handle.
4. Stainless steel hold open arm with aluminum latch.
5. Stainless steel hardware throughout.
6. Load rated at 300 psf.

## 2.7 ATTIC ACCESS HATCHES.

A. Prefabricated Single Leaf Access DoorType K:

1. Manufacturers: Bilco Type K.

2. Provide access hatches with integral curbs where noted.

3. Door leaf shall be 1/4" aluminum plate with neatly welded 3 in. beaded flange.

4. Extruded aluminum frame.

5. ¼" aluminum diamond plate cover.

6. Torsion/cam operating mechanism

7. Standard slam lock

8. Automatic hold open arm with red vinyl grip.

9. 1/8" x 1" steel anchor strap

10. Continuous neoprene cushion.

11. Steel Cast hinges

12. Lock strike

13. Factory finish on aluminum surfaces shall be mill finish with Tnemec coating applied to surfaces in contact with concrete. ( See section 09 91 00)

14. Manufacturer shall warranty in writing against defects in material and workmanship for 5 yrs.

## 2.8 MISCELLANEOUS ITEMS.

A. Fabricate miscellaneous framing, supports, and items of structural shapes, plates, bars, and tubing of sizes and arrangements indicated and as required.

## 2.9 ALUMINUM FLOOR ACCESS DOOR.

A. The angle frame floor access door shall be Model APS150 as manufactured by U.S.F. Fabrication, Inc. with the size being specified on the plans.

B. Cover: 3/16-inch (4.8mm) aluminum diamond plate cover reinforced for 150 psf (733 kg/m2) live load. Equipped with cast aluminum flush lifting handle and 316 stainless steel hold-open arm with red vinyl grip that automatically keeps the cover in its open/upright position.

C. Frame: Extruded aluminum with integral anchor flange and door seat on all four sides.

D. Hardware: 316 stainless steel hinges and tamper resistant bolts/lock nuts.

E. Security: Aluminum staple protrudes through cover for user supplied padlock.

F. Finish: Aluminum cover and frame have mill finish which is protected during shipping and installation by an attached adhesive-backed vinyl material with bituminous Tnemec coating applied to surfaces in contact with concrete. ( See section 09 91 00)

G. Warranty: Manufacturer shall guarantee against defects in materials and workmanship for a period of ten years.

**PART 3 - EXECUTION:**

**3.1 EXAMINATION.**

A. Verify that field conditions are acceptable and are ready to receive Work.

B. Preparation

1. Clean and strip primed steel items to bare metal where site welding is required.

2. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate Sections.

**3.2 INSTALLATION.**

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Perform field welding in accordance with AWS D1.1.

D. Obtain Engineer approval prior to site cutting or making adjustments not scheduled.

E. Perform cutting, drilling and fitting required for installation of metal fabrications. Set the work accurately. Provide temporary bracing and anchors in formwork for items to be built into masonry or concrete. Field weld joints not shop welded because of size limitations. Grind welds smooth and touch-up shop paint coat. Do not weld, cut or abrade surfaces that have been galvanized.

F. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

G. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

H. Protect aluminum in contact with dissimilar material with asphalt paint to provide 2 mil dry thickness. Paint miscellaneous metal work which is to be in contact with but not fully embedded in concrete or masonry with a heavy coat of asphalt paint. Coating shall not extend onto surfaces which will be exposed.

I. Install hatches and manufactured items in accordance with manufacturer's instruction.

J. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

K. Touch up damaged galvanizing with cold galvanizing compound as produced by Rust-Oleum Corp. or ZRC Chemical Company, Quincy, Mass.

**END OF SECTION 05 50 00**

**DIVISION 5 - METALS**

**SECTION 05 50 20 – METAL BAR RACK**

**PART 1 – GENERAL:**

**1.1 WORK INCLUDED.**

A. The Contractor shall provide all labor, materials, equipment, and services required to furnish, install, and place in satisfactory operation the metal bar rack and all appurtenances as shown on the Plans, as specified herein or as required for a complete installation.

B. The Contractor shall provide a rake for use with the metal bar rack and any accessories required for wall mounting the rake at a location within the pump station as directed by the Engineer or Owner.

**1.2 RELATED WORK.**

A. Work under this Section is also subject to the requirements specified under Division 1 of these Special Provisions.

B. Section 05 05 23: Bolts, Anchor Bolts, Concrete Anchors, Concrete Inserts

C. Section 05 50 00: Metal Fabrications

D. Section 09 91 00: Painting

**1.3 REFERENCES.**

A. Stainless Steel products shall conform to the latest editions of the following:

1. **ASTM A276/A276M-17**: Standard Specification for Stainless Steel Bars and Shapes
2. **AWS D1.6/D1.6M-2017**: Structural Welding Code - Stainless Steel (ANSI)
3. **ASTM F593-17**: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
4. **ASTM F594-09(2015)**: Standard Specification for Stainless Steel Nuts
5. **SSPC-SP 16-2010**: Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

**1.4 QUALITY CONTROL.**

A. The bar rack and appurtenances shall be furnished by an established and reputable fabricator with five (5) years of experience with similar type fabrications.

## 1.5 SUBMITTALS.

A. The Contractor shall prepare and submit for approval the drawings and details of the bar rack and miscellaneous appurtenances that demonstrates the following items:

1. Product data and detailed assembly drawings with dimensions and anchors.

2. Certified drawings indicating materials of construction, including the material thickness of all structural components.

3. Mill certificates and signed statements from fabricators certifying alloys from which work is fabricated with delivery of material and equipment.

4. Coatings or other protection against corrosion.

5. Design load calculations.

B. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.7, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

## 1.6 BASIS OF PAYMENT.

A. The work under shall be paid as part of the Contract lump sum price for PUMP STATION MECHANICAL WORK which shall be payment in full for the work described herein.

# PART 2 – PRODUCTS:

## 2.1 GENERAL.

A. Materials

1. Bar rack shall be of heavy duty stainless steel construction unless otherwise noted. The bar rack shall be fabricated into a single unit. Castings shall be thoroughly cleaned and subjected to careful inspection before installation. Finished surfaces shall be smooth and true to assure proper fit.

2. Nuts, bolts, fasteners, and other appurtenant items shall be type 304 stainless steel.

B. Design and Performance

1. Width of clear opening between bars: 1-1/2”

2. Bar size: 3/8” width x 3” depth

3. Channel width: 5’-0”

4. Channel bottom to operating floor height: 9’-0”

5. Angle of installation (from horizontal): 60 degrees

C. The bar rack shall be anchored directly to the concrete channel, spanning the full width and depth of the channel.

D. Reinforce the bar rack to meet all anticipated loads, including the maximum head differential possible in the channel.

E. Rake

1. The rake head and teeth shall be constructed of 1/8” thick type 304 stainless steel plate with tooth penetration of at least 2 inches. Rake teeth shall mesh with bar spacing of rack with an 18” wide head. Provide aluminum or fiberglass handle of a length equal to the inclined length of rack plus 4.5 feet. Handles shall be telescoping and collapse to approximately one half the fully extended handle length.

2. Provide clips and any required accessories for hanging the rake on the wall.

**PART 3 – EXECUTION:**

**3.1 INSTALLATION.**

A. The frame of metal structures shall be installed true and plumb. Temporary bracing shall be placed wherever necessary to resist all loads to which the structure may be subjected, including those applied by the installation and operation of equipment. Such bracing shall be left in place as long as may be necessary for safety.

B. Install suitable hangers on the wall, where directed, for supporting bar rack rake.

**3.2 PAINTING.**

A. Field painting shall be in accordance with the requirements specified under Section 09 91 00, Painting.

B. All aluminum, stainless steel, and other metal surfaces in contact with dissimilar metals shall be painted to prevent contact between dissimilar metals. Aluminum in contact with concrete shall be coated to prevent direct metal contact to concrete.

**END OF SECTION 05 50 20**

**DIVISION 6 - CARPENTRY**

**SECTION 06 61 00 - ROUGH CARPENTRY**

**GENERAL:**

**SECTION INCLUDES.**

Wood nailers.

Blocking at roof system.

Other miscellaneous wood blocking as required or as noted.

Shoring and temporary protection.

**REFERENCES.**

ASTM A525 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-dip Process.

ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

Federal Specifications (FS):
FF-B-575C - Bolts, Hexagon and Square.
FF-N-105B - Nails, Brads, Staples, and Spikes.
FF-N-836D - Nut, Square, Hexagon, Cap, Slotted, Castle. Knurled, Welding, and Single Ball Seat.
FF-S-111D - Screw, Wood.

**QUALITY ASSURANCE.**

Grading Rules:
Lumber Grading Rules and wood species shall conform with Voluntary Product Standard PS20. Grading rules of the following associations shall also apply to materials produced under their supervision.
Northeastern Lumber Manufacturers Association, Inc. (NELMA).
Southern Pine Inspection Bureau (SPIB).
West Coast Lumber Inspection Bureau (WCLIB).
Western Wood Products Association ((WWPA).
Redwood Inspection Service (RIS).

Grade Marks: Identify all lumber by official grade mark.
Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, where applicable and condition of seasoning at time of manufacture.
S-Dry: Maximum 19 percent moisture content.
MC-5 or KD: Maximum 15 percent moisture content.

Dense.

**SUBMITTALS.**

Submit under provisions of Division 1.

Rough Carpentry: Submit certification that lumber and connection material conforms to specified minimum grade.

**DELIVERY, STORAGE, AND HANDLING.**

A. Deliver, store, protect and handle products to site under provisions of Division 1 and in accordance with the manufacturer's instructions.

**BASIS OF PAYMENT.**

A. Payment for work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

**MATERIALS:**

**BLOCKING, NAILING, ETC.**

A. Shall be construction grade douglas fir, hem-fir, or No.1 common southern pine.

**FASTENERS FOR WOOD NAILERS FOR ROOFING.**

A. Shall be not less than 4.76 mm (3/16-inch) diameter stainless steel, zinc coated steel, or equivalent zinc-coated wire anchors, spaced 24 inches on center.

**PRESSURE TREATMENT OF WOOD.**

A. Shall comply with applicable requirements of AWPA C1, C2, and C9.Preservative shall be CA-B (Copper Azole Type B) minimum retention of 0.25. After treatment, kiln-dry lumber to maximum moisture content of 19%.

**2.4 BLOCKING, NAILERS AND OTHER ITEMS.**

A. Whether or not covered by other materials, shall be pressure treated.

**2.5 WOOD FRAMING MEMBERS & DIMENSIONAL LUMBER IN CONNECTION WITH ROOFING AND FLASHING.**

A. Shall be pressure treated.

**2.6 LUMBER FOR TEMPORARY PROTECTION.**

A. Shall be southern yellow pine and an exterior type, Grade C, plugged fir plywood.

**2.7 ANCHORS, CONNECTORS, AND FASTENINGS, NOT INDICATED OR SPECIFIED OTHERWISE.**

A. Shall be of the type, size, and spacing necessary to suit the conditions encountered and as recommended by the National Lumber Manufacturer's Association. Sizes, types, and spacing of nails, screws, or bolts for installation of manufactured building materials, shall be as recommended by the product manufacturer unless indicated or specified otherwise; bolts, nuts, washers, and all other rough hardware embedded in, or in contact with, exterior walls of masonry shall be zinc-coated, except as specified otherwise. Rough hardware shall be formed and punched before coating.

**PART 3 – EXECUTION:**

**3.1 MEMBERS.**

A. Shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Provide blocking where indicated and as necessary to secure the work.

**3.2 ALL FIELD-CUT EDGES AND SURFACES OF TREATED LUMBER.**

A. Shall be liberally coated with a concentrated solution of preservative.

**3.3 DELIVERY AND STORAGE.**

A. Protect lumber against dampness before and after delivery. Store under cover in a well-ventilated area and where not exposed to extreme changes in temperature or humidity until used.

**END OF SECTION 06 10 00**

**DIVISION 6 – WOOD, PLASTICS AND COMPOSITES**

**SECTION 06 60 00 - FIBERGLASS REINFORCED PLASTIC PRODUCTS AND FABRICATIONS**

**PART 1 – GENERAL:**

**1.1 SCOPE OF WORK.**

A. Design, fabrication and Furnishing all labor, materials, equipment and incidentals necessary to install the fiberglass reinforced plastic (FRP) products as specified herein.

1. Handrails.
2. Ladder.
3. Stairs.

**1.2 QUALITY ASSURANCE.**

A. The material covered by these specifications shall be furnished by a reputable and qualified manufacturer of proven ability who has regularly engaged in the manufacture and installation of FRP systems.

B. Substitution of any component or modification of system shall be made only when approved by the Engineer.

C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

E. Provide a written certification that the products have been installed in accordance with the requirements under this Section.

F. The installing contractor shall be approved by the FRP manufacturer.

**1.3 DESIGN CRITERIA.**

B. The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.

**1.4 SUBMITTALS.**

A. Shop drawings of all FRP structural members, handrails, plate, ladders, stairs and appurtenances shall be submitted to the Engineer for review.

B. Manufacturer's catalog data showing:

1. Dimensions, spacings, and construction.
2. Materials of construction.
3. Chemical resistance table.

C. Detailed shop drawings showing:

1. Dimensions.
2. Sectional assembly.
3. Location and identification mark.
4. Size and type of supporting frames required.

## 1.5 SHIPPING AND STORAGE INSTRUCTIONS.

A. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting and installation.

B. Items shall be covered and protected from exposure to sun or ultra violet light during storage.

C. All materials and equipment necessary for the fabrication and installation of the plate, handrails, and structural shapes shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun.

D. Any material which, in the opinion of the Engineer, has become damaged as to be unfit for use shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.

E. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

## 1.6 BASIS OF PAYMENT.

A. Specialties shall be paid for as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for work described herein.

## PART 2 – PRODUCTS:

## 2.1 GENERAL.

A. Materials used in the manufacture of the FRP products shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.

B. All materials shall be of the kind and quality specified, and where the quality is not specified, it shall be the best of the respective kinds and suitable for the purpose intended.

1. Resins shall be VINYL ESTER resin for ladders and other members that may be submerged in the wet well or discharge chamber and in continuous contact with water.
2. Resins for members for exterior or dry service shall be either polyester or vinyl ester resin.

C. After fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating to prevent intrusion of moisture.

D. All exposed surfaces shall be smooth and true to form.

E. FRP Manufacturers:

1. Strongwell-Chatfield Division, Chatfield, MN.
2. Composite Structures International, Inc.
3. Bedford Plastics, Inc.
4. Augusta Fiberglass.
5. Ultra, Inc.
6. Or approved alternative manufacturer.

## 2.2 HANDRAIL / GUARDRAIL.

A. All handrail / guardrail systems shall be compliant to OSHA 1910.23

B. All posts, and rails are to be FRP structural shapes manufactured by the pultrusion process. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions specified in the Contract Documents.

C. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

D. Resins shall be a fire-retardant isophthalic polyester resin with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.

E. Posts, top and mid rails are to be 2"x2”x0.25" wall square tube and kickplate is to be ½" x 4" with two reinforcing ribs. The bases of the posts are to be reinforced to a height of 10" using a high strength epoxy compound.

F. The handrail post/rail connection is to be fabricated such that the rails are unbroken and continuous through the post without the use of packs or splices. The mid rail is to be installed through the post at a prepared hole made to fit the outside dimensions of the rail. The top rail is to fit into a machined, u-shaped pocket formed into top of the post such that the rail is located at the center of the post. All exposed post corners are to be radiused to eliminate sharp edges. The rails are to be joined to the post through a combination of bonding and riveting. No sharp, protruding edges are to remain after assembly of the handrail. Spacing of the posts shall not exceed 5'-0".

G. All rails, posts, and kick plates are to be integrally pigmented yellow.

H. All fasteners and rivets shall be SAE 304 stainless steel, conforming to ASTM A593 304 Condition A.

## 2.3 LADDER.

A. Ladder rails shall be 2”x2”x0.25” square tube. Ladder rungs shall be 1” diameter with non-skid surface.

B. Ladder support brackets are to be installed at a maximum of 4’-0” on center. All hardware is to be 316 Stainless steel.

C. Ladders are to be integrally pigmented yellow.

D. Where noted on Drawings provide Bilco LadderUP model LU-3 retractable safety post extension at top of ladder.

## 2.4 STAIR.

A. Construct stairs and platforms of frp channel stringers and framing members with a fire retardant isophthalic polyester resin to support uniform live load of 100 psf or a moving concentrated load of 1000 lbs, whichever produces the greatest stress.

B. Exposed ends of stringers with plates, continuously welded to main member.

C. Grating and Treads.

1. Provide shop-fabricated grating and accessories such as frames, support angles, and fasteners.

2. Grating and treads shall be of integrally pigmented frp.

3. Treads and exposed edges of grating platforms shall have 1 ½” deep molded or pultruded frp with non-skid abrasive grit surface and wide nosings.

4. Provide fastening devices to firmly anchor grating and treads to supports.

a. Min of 4 per panel.
b. Saddle clip type.
c. “G” clip type.
d. Clamp type.
e. Min 1/2 in. bolts or self tapping screws.
f. 316 stainless steel.

**PART 3 – EXECUTION:**

**3.1 PREPARATION.**

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

**3.2 INSPECTION AND TESTING.**

A. The Engineer shall have the right to inspect and test all materials to be furnished under these specifications prior to their shipment from the point of manufacture.

B. All labor, power, materials, equipment and appurtenances required for testing shall be furnished by the Contractor at no cost to the Owner.

C. Members and components shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits.

**3.3 INSTALLATION.**

A. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required.

B. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels. All field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer. The sealing of the edges shall prevent premature fraying at the field cut edges.

C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

D. At all unsupported cutouts, install hold downs at uncut bearing bars beyond cutout area and install support bars from hold down to hold down. Lock grating panels securely in place with hold-down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products

E. Install items specified as indicated and in accordance with manufacturer's instructions.

**END OF SECTION 06 60 00**

## DIVISION 7 - THERMAL AND MOISTURE PROTECTION

## SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. This Section includes the following:

1. Modified bituminous sheet waterproofing.
2. Protection Board.

B. Related Sections include the following:

1. Division 07 Section “Mineral Wool Insulation” for thermal insulation.

### 1.3 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Samples: For the following products:

1. 12-by-12-inch square of waterproofing and flashing sheet.
2. 12-by-12-inch square of insulation.
3. 12-by-12-inch square of protection board.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for waterproofing.

G. Warranties: Special warranties specified in this Section.

## 1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that is approved by the waterproofing manufacturer for installation of waterproofing required for this Project.

B. Source Limitations: Obtain waterproofing materials, protection board, through one source from a single manufacturer.

C. Mockups: Before beginning installation, install waterproofing to 100 sq. ft. to demonstrate surface preparation, crack and joint treatment, corner treatment, and execution quality.

1. If Engineer determines mockups do not comply with requirements, reapply waterproofing and reinstall until mockups are approved.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

## 1.6 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

## 1.7 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace waterproofing material that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch in width.

2. Warranty Period: Five years from date of Substantial Completion.

3. Warranty includes removing and reinstalling protection board.

## 1.8 BASIS OF PAYMENT

A. The work specified under this Section shall be paid for at the contract unit price per square yard for SHEET WATERPROOFING MEMBRANE SYSTEM, which price shall be considered as payment in full for this item.

# PART 2 - PRODUCTS

## 2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Not less than 60-mil- thick, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated to a 4-mil- thick, polyethylene film with release liner on adhesive side and formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Hydrotech, Inc.; MM6125.
b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
c. CETCO Building Materials Group; Envirosheet.
d. Grace, W. R. & Co.; Bituthene 4000.
e. Henry Company; Blueskin WP 200.
f. Meadows, W. R., Inc.; SealTight Mel-Rol.
g. Chargar Corporation; SubSeal 60.
h. Polyguard Products; Polyguard 650.
i. Tamko, Inc.; TW-60.

2. Physical Properties:

a. Tensile Strength: 250 psi minimum; ASTM D 412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.

e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
f. Hydrostatic-Head Resistance: 150 feet minimum; ASTM D 5385.
g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
h. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method

## 2.2 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of sheet waterproofing material.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.

F. Sheet Strips: Self-adhering, rubberized-asphalt sheet strips of same material and thickness as sheet waterproofing.

G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

1. Detail Tape: Two-sided, pressure-sensitive, self-adhering reinforced tape, 4-1/2 inches wide, with a tack-free protective adhesive coating on one side and release film on self-adhering side.
2. Detail Strips: 62.5-mil thick, felt-reinforced self-adhesive strip, 9 inches wide, with release film on adhesive side.

H. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick, predrilled at 9-inch centers.

I. Protection Board: Fan folded, with a core of extruded-polystyrene board insulation faced one side with plastic film, nominal thickness 1/4 inch, with compressive strength of not less than 8 psi per ASTM D 1621, and maximum water absorption by volume of 0.6 percent per ASTM C 272. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

F. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.

G. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

## 3.3 FIELD QUALITY CONTROL

A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; membrane application, flashings, protection, and drainage components; and to furnish daily reports to Engineer.

## 3.4 PROTECTION AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed Modified Bituminous Sheet Waterproofing, Protection Board and Insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation 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 07 13 26**

**SECTION 07 20 00 - BOARD INSULATION**

**PART 1 – GENERAL:**

**1.1 SECTION INCLUDES.**

A. Cavity Wall: 2" thick board insulation for cavity wall.

B. Foundation Wall: 2” thick board insulation for foundation wall to 4’-6” below grade.

**1.2 RELATED SECTION.**

A. Division 03 30 00 – Cast-in Place Concrete.

B. Section 04 10 00 - Unit Masonry System.

**1.3 REFERENCES.**

A. ASTM C272 - Water Absorption of Core Materials for Structural Sandwich Constructions.

B. ASTM C591 – UnFaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation Board.

C. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

D. ASTM C1621 - Compressive Properties of Rigid CellularPlastics.

E. ASTM D1622 - Apparent Density of Rigid Cellular Plastics.

F. ASTM D2126 - Response of Rigid Cellular Plastics to Thermal and Humid Aging.

G. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

H. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

I. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.

**1.4 SYSTEM DESCRIPTION.**

A. Materials of this Section shall provide a continuous thermal barrier at building enclosure elements.

**1.5 SUBMITTALS.**

A. Submit under provisions of Division 1, Section 01 01 00, Summary of Work.

B. Product Data: Provide data on product characteristics, performance criteria, and limitations.

C. Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation and installation techniques.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

## 1.6 DELIVERY, STORAGE, AND PROTECTION.

A. Deliver, store, protect and handle products to site under provisions of Division 1 and in accordance with the manufacturer's instructions.

## 1.7 ENVIRONMENTAL REQUIREMENTS.

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

## 1.8 BASIS OF PAYMENT.

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for PUMP STATION GENERAL WORK.

## PART 2 – PRODUCTS:

## 2.1 MANUFACTURERS - INSULATION MATERIALS.

A. The Apache Products Company: Polyisocyanurate Insulation

B. Celotex Corporation

C. Johns Manville Corporation

D. Substitutions: Under provisions of Division 1.

## 2.2 INSULATION MATERIALS.

A. Polyisocyanurate Insulation: ASTM C591 rigid, cellular type, conforming to the following:

1. Thermal Resistance: R-value of 6 per inch.

2. Compressive Strength: 20 psi minimum per ASTM D1621.

3. Water Absorption: In accordance with ASTM C2842, less than 1.5 percent by volume maximum.

4. Board Edges: Square

5. Board Thickness: 2" min. thickness for walls and foundations. Foundation walls to 4'-6" below grade minimum for frost protection.

6. Board Density: (2.0 lbs/cu. ft.)

## 2.3 ADHESIVE MATERIALS.

A. Adhesive: Type recommended by insulation manufacturer for application.

## 2.4 ACCESSORIES.

A. A ½" or 5/8" fiber board for protection of rigid insulation surfaces.

B. Nails or Staples: Steel wire; galvanized; type and size to suit application.

C. Insulation Fasteners: Impale clip type of galvanized steel; of type to be mechanically fastened to surface to receive rigid insulation; length to suit insulation thickness; capable of securely and rigidly fastening insulation in place.

# PART 3 – EXECUTION:

## 3.1 EXAMINATION.

A. Verify substrate and adjacent materials and insulation boards are dry and ready to receive insulation and adhesive.

B. Verify substrate surface is flat, free of honeycomb, fins, irregularities and materials that may impede adhesive bond.

C. Verify insulation boards are unbroken, free of damage.

## 3.2 INSTALLATION – MASONRY CAVITY WALLS AND FOUNDATION WALLS.

A. Secure impale fasteners to substrate at a frequency of 6 per insulation board.

B. Adhere a 6 inch wide strip of polyethylene sheet over control and expansion joint with double beads of adhesive each side of joints. Tape seal joints between sheets. Extend sheet full height of joint.

C. Apply adhesive in three continuous beads per board length to full bed 1/8 inch thick on substrate. Daub adhesive tight to protrusions to ensure continuity of vapor and air barrier.

D. Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent boards and no protrusions. Place impale fastener locking discs.

E. Cut and fit insulation tight to protrusions or interruptions to the insulation plane.

F. In masonry cavity walls, coordinate placement of rigid insulation boards with installation of masonry wire reinforcing, brick ties, flashing and other masonry and insulation accessories, and in accordance with manufacturer's instructions.

G. Cut and fit insulation tight to cavity wall protrusions and interruptions to the insulation plane.

## 3.3 PROTECTION OF FINISHED WORK.

A. Protect finished work under provisions of Division 1.

B. Do not permit work to be damaged prior to covering insulation.

**END OF SECTION 07 20 00**

**DIVISION 07 – THERMAL AND MOISTURE PROTECTION**

**SECTION 07 21 10 - MINERAL WOOL INSULATION**

**GENERAL:**

**SUMMARY.**

Mineral wool insulation for the following applications:
Thermal and acoustical insulation.

**SUBMITTALS.**

Product Data: Manufacturer's data sheets on each product to be used, including preparation instructions and recommendations, storage and handling requirements, and installation methods.

Shop Drawings: Submit manufacturer's shop drawings describing the type and location of each product specified.

Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product.

**QUALITY ASSURANCE.**

Installer Qualifications: The installation work of this Section shall be performed by an experienced contractor with a minimum of 2 years experience installing similar assemblies.

Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, materials proposed for use, sequence of construction, coordination with substrate preparation, compatibility of materials, coordination with installation of adjacent and covering materials. Attendance is required by representatives of related trades including covering materials, substrate materials and adjacent materials.

**DELIVERY, STORAGE, AND HANDLING.**

Delivery: Deliver materials to the job site in original packages, containers, or bundles bearing the brand name and manufacturer's identification.

Storage: Store materials in dry locations with adequate ventilation, free from water, and in such a manner to permit easy access for inspection and handling.

Handling: Handle using procedures recommended by the manufacturer for materials and personnel.

**WARRANTY.**

Warranty: Provide manufacturer's standard limited warranty against manufacturing defects.

**PRODUCTS:**

**MANUFACTURER.**

Basis-of-Design Manufacturer: Thermafiber, Inc. (an Owens Corning company), One Owens Corning Parkway, Toledo, OH 43659. Toll free 888-834-2371, Fax 260-563-8979, www.thermafiber.com.

Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

**THERMAL AND ACOUSTICAL INSULATION.**

Thermal / Acoustical Insulation:
Product: Thermafiber® UltraBatt™; foil faced.
R-Value: R-10, R-15, R-23, R-24, R30 as applicable.
Surface Burning Characteristics (excluding UltraBatt FF): Tested in accordance with ASTM E84.
Foil Faced: Flame Spread 25 and Smoke Developed 0.
Corrosivity: Non-corrosive, when tested in accordance with ASTM C665.
Fiber Type: EPA Choice fiber; minimum 75 percent pre-consumer recycled content; complies with EPA Preference Program.
Fiber Type: Standard fiber; 70 percent pre-consumer recycled content.
Post-Consumer Recycled Content: 0 percent.
UL Certified Environmental Product Declaration in accordance with ISO 14025. Applies to all products except SAFB FF and UltraBatt FF.

**EXECUTION:**

**EXAMINATION.**

Examine the areas and conditions under which work of this section will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

**INSTALLATION.**

Comply with tested and listed systems. Install products in proper relationship with each other and adjacent construction and as follows:

**PROTECTION.**

Protect installed products from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION 07 21 10**

**DIVISION 7 – THERMAL AND MOISTURE PROTECTION**

**SECTION 07 31 13 – ASPHALT SHINGLES**

**PART 1 - GENERAL:**

**1.1 SECTION INCLUDES.**

A. Ventilated roof insulation panels.

B. Asphalt roofing shingles.

C. Leak barrier and moisture shedding roof deck protection.

D. Underlayment.

E. Metal flashing associated with shingle roofing.

F. Attic ventilation and ventilation accessories.

**1.2 RELATED SECTIONS.**

A. Section 06100 - Rough Carpentry.

B. Section 07620 - Sheet Metal Flashing and Trim.

**1.3 REFERENCES.**

A. AC438-1011-R1 - New Acceptance Criteria for Alternative Asphalt Roofing Shingles

B. American Society of Civil Engineers (ASCE): ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

C. Asphalt Roofing Manufacturers Association (ARMA).

D. ASTM International (ASTM):
1. ASTM D 3018 - Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules.
2. ASTM D 3161 - Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method).
3. ASTM D 3462 - Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.
4. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
5. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
6. ASTM B 370 - Standard Specification for Copper Sheet and Strip for Building Construction.
7. ASTM C 1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
8. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
9. ASTM E 903 - Standard Test Method for Solar Absorption, Reflectance and

Transmission of Materials Using Integrating Spheres.

E. Cool Roof Rating Council (CRRC).

F. ENERGYSTAR.

G. National Roofing Contractors Association (NRCA).

H. Sheet Metal and Air Conditioning Contractors National Association, 1nc. (SMACNA) - Architectural Sheet Metal Manual.

I. U.S. Green Building Council (USGBC): Leadership in Energy and Environmental Design (LEED).

J. Underwriters Laboratory (UL)
1. UL 790 - Tests for Fire Resistance of Roof Covering Materials.
2. UL 997 - Wind Resistance of Prepared Roof Covering Materials.

## 1.4 DEFINITIONS.

A. Roofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual for definitions of roofing terms related to this section.

## 1.5 SUBMITTALS.

A. Submit under provisions of Section 01300 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, showing compliance with requirements.

C. Installation Instructions: Manufacturer's installation instructions, showing required preparation and installation procedures.

## 1.6 QUALITY ASSURANCE.

A. Manufacturer Qualifications: Provide all primary roofing products, including shingles, underlayment, leak barrier, and ventilation, by a single manufacturer.

B. Installer Qualifications: Installer must be approved by manufacturer for installation of all roofing products to be installed under this section.

C. USGBC LEED: Provide products meeting solar reflective index required to achieve LEED Credit for Roof Heat Island Effect.

## 1.7 REGULATORY REQUIREMENTS.

A. Provide a roofing system achieving an Underwriters Laboratories (UL) Class A fire classification.

B. Install all roofing products in accordance with all federal, state and local building codes.

C. All work shall be performed in a manner consistent with current OSHA guidelines.

**1.8 PRE-INSTALLATION MEETINGS.**

A. Convene a pre-installation meeting a minimum two weeks prior to starting work of this section.
   1. Contractor shall schedule and arrange meeting and meeting place and notify attendees.
   2. Mandatory Attendees: Roofing installer and manufacturer's steep slope technical representative (not sales agent).
   3. Optional Attendees: Owner's representative, Architect's representative, prime Contractor's representative.
   4. Review all pertinent requirements for achieving the warranty specified below and set schedule for final warranty inspection.

**1.9 DELIVERY, STORAGE, AND HANDLING.**

A. Store products in manufacturer's unopened labeled packaging until ready for installation.

B. Store products in a covered, ventilated area, at temperature not more than 110 degrees F (43 degrees C); do not store near steam pipes, radiators, or in sunlight.

C. Store bundles on flat surface to maximum height recommended by manufacturer; store rolls on end.

D. Store and dispose of solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

**1.10 WEATHER CONDITIONS.**

A. Proceed with work only when existing and forecasted weather conditions will permit work to be performed in accordance with roofing shingle manufacturer's recommendations.

**1.11 WARRANTY.**

A. Provide manufacturer's standard limited warranty:
   1. Provide to the Owner a GAF WeatherStopper Golden Pledge Ltd Warranty.
      a. Warranty Duration: 15 years.

**PART 2 - PRODUCTS:**

**2.1 MANUFACTURERS.**

A. Acceptable Manufacturer: GAF, Residential Roofing Products, which is located at: 1 Campus Drive Parsippany, NJ 07054; Toll Free Tel: 800 ROOF-411; Tel: 800-766-3411; Fax: 973-628-3451; Email: TechnicalQuestionsGAF@gaf.com; Web: www.gaf.com.

B. Requests for substitutions will be considered in accordance with provisions of Section 01600 - Product Requirements.

**2.2 SHINGLES.**

A. Glenwood Lifetime Designer Shingles, by GAF:
   1. Triple layer granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents

pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Ultra-dimensional and bold profile provide a bold unique appearance with a 4.5in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; Passes UL 2218, Class 4 Impact Test ; AC438 compliant; CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved.

B. Camelot Lifetime Designer Shingles, by GAF:
1. Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Extra thick tabs and bold profile provide a bold unique appearance with a 7.5in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

C. Grand Sequoia Lifetime Designer Shingles, by GAF:
1. Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and mineral granule surfacing.
2. Special cut tabs and bold profile provide a rugged hand-split shake appearance with an 8 in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

D. Grand Canyon Lifetime Designer Shingles, by GAF:
1. Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Special cut tabs and bold profile provide a rugged hand-split shake appearance with an 8in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

E. Grand Sequoia ArmorShield Lifetime Designer Shingles, by GAF:
1. UL 2218, Class 4, granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and mineral granule surfacing.
2. Special cut tabs and bold profile provide a rugged hand-split shake appearance with an 8 in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; Passes UL 2218, Class 4 Impact Test ; AC438 compliant; CSA 123.5-98; Dade County Approved,

Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

F. Monaco Lifetime Designer Shingles by GAF:
1. Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Special cut tabs give the appearance of clay barrel roof tiles.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

G. Woodland Lifetime Designer Shingles by GAF:
1. Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Special cut tabs give the appearance of staggered slate.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

H. Sienna Lifetime Designer Shingles by GAF:
1. Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant CSA 123.5-98; Florida Building Code Approved,; Texas Dept of Insurance Approved.

I. Slateline Lifetime Designer Shingles, by GAF:
1. Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Dovetail cut tabs and bold shadow lines provide a slate appearance with a 7 ½ in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

J. Camelot II Lifetime Designer Shingles, by GAF:
1. Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of

granules.
2. Thick tabs and bold profile provide a bold unique appearance with a 7.5 in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Class F, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98, Texas Dept of Insurance Approved, ICC Report Pending,

K. Timberline Ultra HD Lifetime High Definition Shingles, by GAF:
1. Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Architectural laminate styling provides a wood shake appearance with a 5 5/8 in. exposure. Features GAF's patented High Definition color blends and enhanced shadow effect. .
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

L. Timberline HD Lifetime High Definition Shingles, by GAF:
1. Self sealing, granule surfaced, asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Architectural laminate styling provides a wood shake appearance with a 5 5/8in. exposure. Features GAF's patented High Definition color blends and enhanced shadow effect.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

M. Timberline Natural Shadow Lifetime Shingles, by GAF:
1. Self sealing, granule surfaced, asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Architectural laminate styling provides a wood shake appearance with 5 5/8in. exposure. Features the classic Natural Shadow effect.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

N. Timberline ArmorShield II Shingles, by GAF:
1. UL 2218, Class 4, granule surfaced self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.

2. Architectural laminate styling provides a wood shake appearance with a 5 5/8in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; Passes UL 2218, Class 4 Impact Test; ASTM D 3462; AC438 compliant; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

O. Timberline Cool Series Lifetime Shingles, by GAF:
1. Granule surfaced, high reflectance, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and a mineral granule surfacing.
2. Architectural laminate styling provides a wood shake appearance with a 5 5/8in. exposure. Features highly reflective roofing granules that bounce back the sun's rays and more effectively release absorbed heat.
3. Rated by the Cool Roof Rating Council (CRRC), Title 24 compliant and meets initial Energy Star performance levels.
4. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

P. Marquis Weathermax Shingles, by GAF:
1. Granule surfaced self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and a mineral granule surfacing.
2. Traditional 3-tab styling with a 5 in. or 5 5/8 in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98.

Q. Royal Sovereign Shingles, by GAF:
1. Granule surfaced self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules.
2. Traditional 3-tab styling with a 5 in. or 5 5/8 in. exposure.
3. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; Dade County Approved, Florida Building Code Approved, Texas Dept of Insurance Approved, ICC Report Approval.

## 2.3 HIP AND RIDGE SHINGLES.

A. Distinctive impact resistant self-sealing hip and ridge cap shingle complementing the color of selected roof shingle. Each bundle covers approx. 25 lineal feet (7.62m) with a 6 2/3 inch (169mm) exposure. Seal-A-Ridge ArmorShield Ridge Cap Shingles by GAF.

## 2.4 STARTER STRIPS.

A. Self sealing starter shingle designed for all roof shingles. Each bundle covers approx. 120 lineal feet (36.58m). ProStart Starter Strip by GAF.

B. Pre-cut, color coordinated starter strip shingle designed as a second starter course for shingles with large cut-outs. Each bundle covers approx.. 60 lineal feet (18.29 m)

StarterMatch Starter Strip by GAF.

**2.5 LEAK BARRIER.**

A. Self-adhering, self-sealing, bituminous leak barrier surfaced with fine, skid-resistant granules. Approved by UL, Dade County, ICC, State of Florida and Texas Department of Insurance. Each roll contains approx. 150 sq ft (13.9 sq.m.), 36 inches X 50 feet (0.9m x 20.3m) or 200 sq ft (18.6 sq.m.), 36 inches X 66.7 feet (0.9m x 20.3m). WeatherWatch Leak Barrier, by GAF.

**2.6 UNDERLAYMENT.**

A. #30 Roofing Underlayment: Water repellent breather type cellulose fiber building paper. Meets or exceeds the requirements of ASTM D 4869 Type II.

**2.7 ROOFING CEMENT.**

A. Asphalt Plastic Roofing Cement meeting the requirements of ASTM D 4586, Type I or II.

**2.8 ROOF ACCESSORIES.**

A. Paint: Exterior acrylic rust resistant aerosol roof accessory paint. Each 6 oz can is available in boxes of 6 and in color to compliment the roof. Shingle-Match Roof Accessory Paint by GAF.

B. Compression Collars: UV stable solid molded PVC compression collar, Kynar PVDF coated 24 gauge galvanized flange, Ultimate Pipe Flashing by Lifetime Tool.

**2.9 ATTIC VENTILATION.**

A. Ridge Vents:
   1. Flexible rigid plastic ridge ventilator designed to allow the passage of hot air from attics, while resisting snow infiltration. For use in conjunction with eave/soffit ventilation products. Provides 12.5 sq inches NFVA per lineal foot (26460 sq.mm/m). Each package contains 20 lineal feet (6.10m) of vent. Cobra Ridge Runner Ridge Vent by GAF.

B. Fascia and Soffit/Under Eave Vents:
   1. Flexible rigid plastic ridge ventilator designed to allow the passage of hot air out of attics at the roof top along the eaves. For use in conjunction with ridge ventilation products. Provides 9.0 sq inches (11613 sq.mm/m) in NFVA per lineal foot. Each package contains 40 lineal feet (12.19m) of vent, Cobra IntakePro Rooftop Intake Vent (includes 1-3/4" (44.5 mm) coil nails), by GAF

C. Dual Powered Vents
   1. Dual powered roof exhaust vent designed to remove damaging heat and moisture from attics. Each vent provides 500 CFM and is solar and electric powered to provide continuous operation and reduce related utility costs. Green Machine Dual Powered Roof Exhaust Vent, by GAF.

D. Powered Vents
   1. Powered, rooftop mounted exhaust ventilators designed to evacuate hot air from attics. Each vent permits the passage of 1000 to 1600 c.f.m. Thermostat and/or

humidistat controlled. MasterFlow ERV Series power roof ventilators, by GAF.

**2.10 NAILS.**

A. Nails: Standard round wire, zinc-coated steel or aluminum; 10 to 12 gauge, smooth, barbed or deformed shank, with heads 3/8 inch (9mm) to 7/16 inch (11mm) in diameter. Length must be sufficient to penetrate into solid wood at least 3/4 inch (19mm) or through plywood or oriented strand board by at least 1/8 inch (3.18mm).

**2.11 METAL FLASHING.**

A. Copper: 16-oz/sq ft (0.56mm) copper sheet, complying with ASTM B 370.

**PART 3 - EXECUTION:**

**3.1 EXAMINATION.**

A. Do not begin installation until roof deck has been properly prepared.

B. If roof deck preparation is the responsibility of another installer, notify Architect or building owner of unsatisfactory preparation before proceeding.

**3.2 PREPARATION OF SUBSTRATE.**

A. Clean deck surfaces thoroughly prior to installation of leak barrier and roof deck protection.

B. At areas to receive leak barrier, fill knot holes and cracks with latex filler.

C. Installation shall follow the GAF written installation instructions.

D. Protect nail base insulation work from exposure to moisture damage and deterioration, primarily by prompt installation of the roofing, sheet metal and waterproofing work

**3.3 INSTALLATION OF UNDERLAYMENT.**

A. Install using methods recommended by manufacturer in accordance with local building code. When local codes and application instructions are in conflict, the more stringent requirements shall take precedence.

B. Eaves:
1. Place eave edge metal flashing tight with fascia boards; lap joints 2 inches (50 mm) and seal with plastic cement; nail at top of flange.
2. On roofs with slope between 2:12 and 4:12, and on all roofs in the north, install leak barrier up the slope from eave edge to 36 inches from the edge or at least 24 inches (610 mm) beyond the interior face of the warm exterior wall, whichever is greater; lap ends 6 inches (150 mm) and bond.

C. Hips and Ridges:
1. Install GAF leak barrier along entire lengths. If ridge vents are to be installed, position the GAF leak barrier so that the ridge slots will not be covered.

D. Roof Deck:
1. Install one layer of roof deck protection over entire area not protected by eave or

valley membrane; run sheets horizontally lapped so water sheds; nail in place.

2. On roofs sloped between 2 in 12 and 4 in 12, lap horizontal edges at least 19 inches (480 mm) and at least 19 inches (485 mm) over eave protection membrane.
3. Lap ends at least 4 inches (100 mm); stagger end laps of each layer at least 36 inches (915 mm).
4. Lap roof deck protection over valley protection at least 6 inches (152 mm).

E. Deck-Armor Application
1. Deck-Armor shall be installed over a clean, dry deck.
2. Install Weather Watch or StormGuard Leak Barrier at eaves, valleys, rakes, skylights, dormers and other vulnerable leak areas.
3. Lay Deck-Armor over deck and overlap 3in. (76mm) at side laps and 6in. (152mm) at end laps.
4. For exposure to rain or snow, overlap 12in. (305mm) at end laps.
5. For side and end laps: fasten Deck-Armor 12in. (305mm) o.c. (6in. (152mm) o.c. for high wind areas).
6. For middle of the roll: fasten Deck-Armor 24in. (610mm) o.c. (12in. (305mm) o.c. for high wind areas).
7. For exposure to rail or snow, completely cover all side laps, end laps and fasteners with tape.
8. For long term exposure see complete Deck-Armor installation instructions for side lap detail.
9. If roof may be exposed to high winds, apply tape over all fasteners at the center of the roll to prevent rain or snow from entering at the fasteners.

F. Penetrations:
1. At vent pipes, install a 24 inch (610 mm) square piece of leak barrier lapping over roof deck protection; seal tightly to pipe.
2. At vertical walls, install leak barrier extending at least 6 inches (150 mm) up the wall and 12 inches (305 mm) on to the roof surface lapping over roof deck protection.
3. At skylights and roof hatches, install leak barrier up the sides of the frame and 12 inches (305 mm) on to the roof surface on all sides, lapping over roof deck protection.
4. At chimneys, install leak barrier around entire chimney extending at least 6 inches (152 mm) up the wall and 12 inches (305 mm) on to the roof surface lapping over roof deck protection.
5. At rake edges, install metal edge flashing over leak barrier and roof deck protection; set tight to rake boards; lap joints at least 2 inches (50 mm) and seal with plastic cement; secure with nails.
6. At hips and ridges, install leak barrier along entire lengths. If ridge vents are to be installed, position the leak barrier so that the ridge slots are not covered.

## 3.4 INSTALLATION OF SHINGLES.

A. Install in accordance with manufacturer's instructions and requirements of local building code.
1. Avoid breakage of shingles by avoiding dropping bundles on edge, by separating shingles carefully (not by "breaking" over ridge or bundles), and by taking extra precautions in temperatures below 40 degrees F (4 degrees C).
2. Handle carefully in hot weather to avoid damaging shingle edges.

3. Secure with 4 to 6 nails per shingle; use number of nails required by manufacturer or by code, whichever is greater. Nails must be long enough to penetrate through plywood or OSB, or 3/4 inch (19 mm) into dimensional lumber.

B. Install hip and ridge shingles as required by the manufacturer. At ridges, install hip and ridge shingles over ridge or ridge vent material.

C. All penetrations are to be flashed according to GAF, ARMA and NRCA application instructions and construction details.

## 3.5 INSTALLATION OF VENTILATION.

A. Code Requirements: Ventilation shall meet or exceed current FHA, HUD and local code requirements.

B. Ridge Vents:
1. Cut continuous vent slot through sheathing, stopping 6 inches (150 mm) from each end of ridge.
2. On roofs without ridge board, make slot 2 inches (50 mm) wide, centered on ridge.
3. On roofs with ridge board, make two slots 1-3/4 inches (89 mm) wide, one on each side.
4. Install ridge vent material full length of ridge, including uncut areas.
5. Butt ends of lengths of ridge vent material and join using plastic cement.
6. Install eave vents in sufficient quantity to equal or exceed the ridge vent area, calculated as specified by manufacturer.
7. Install ridge shingles over ridge vent material; use nails of specified length; do not drive nails home, leaving 3/4 inch (19 mm) slot open between ridge and roof shingles.

C. Hip Vents and Rooftop Vents:
1. Install according to manufacturer's instructions.
2. Install vents in sufficient quantity to equal or exceed the exhaust vent area, calculated as specified by manufacturer.

D. Roof Louvers:
1. Cut vent hole through sheathing as specified by the manufacturer for the type of vent to be installed.
2. Install a 24 inches (610 mm) square of leak barrier, centered around the hole
3. Install according to manufacturer's instructions for flashing vent penetrations
4. Install eave vents in sufficient quantity to equal or exceed the exhaust vent area, calculated as specified by manufacturer.

E. Powered (Solar & Dual Powered) Ventilators:
1. Cut vent hole through sheathing as specified by the manufacturer for the type of vent to be installed.
2. On rooftop applications, install a 36 inches (610 mm) square of leak barrier, centered around the hole
3. Install according to manufacturer's instructions for flashing vent penetrations
4. Install eave vents in sufficient quantity to equal or exceed the exhaust vent area, calculated as specified by manufacturer.

F. Whole House Fans:

1. Install at desired locations in ceiling below attic space per manufacturer recommended location and application instructions.

## 3.6 INSTALLATION OF VENTILATION ACCESSORIES.

A. Chimney Caps: Install per manufacturer recommendations.

B. Foundation Vents: Install per manufacturer recommendations

## 3.7 PROTECTION.

A. Stage work progress so that traffic is minimized over completed roofing.

B. Protect installed products until completion of project

**END OF SECTION 07 31 13**

**DIVISION 7 - THERMAL AND MOISTURE PROTECTION**

**SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM**

**GENERAL:**

**SECTION INCLUDES.**

Sill, lintel, base, through wall and cap flashings.

Counter flashing.

Fascias.

Scuppers, downspouts, and accessories.

**RELATED SECTIONS.**

Section 03 30 00 - Cast-In-Place Concrete.

Section 04 10 00 – Unit Masonry.

Section 05 50 00 - Metal Fabrications.

Section 06 10 00 – Rough Carpentry.

Section 07 41 13 – Preformed Metal Standing Seam Roofing.

Section 07 92 00 - Joint Sealers.

Section 43 01 50 - General Mechanical Provisions.

**REFERENCES.**

AISI (American Iron and Steel Institute) - Stainless Steel Uses in Architecture.

ASTM A167 - Stainless and Heat-Resisting Chromium- Nickel Steel Plate.

ASTM B32 - Solder Metal.

FS O-F-506 - Flux, Soldering, Paste and Liquid.

FS QQ-S-571 - Solder, Tin Alloy.

NAAMM - Metal Finishes Handbook.

NRCA (National Roofing Contractors Association) - Roofing Manual.

SMACNA - Architectural Sheet Metal Manual.

ASTM A240 - Heat-resisting, Chromium & Chromium-Nickel Stainless Steel Plate, Sheet, and Strip.

**SUBMITTALS.**

Submit under provisions of Division 1.

Shop Drawings: Provide manufacturer's or fabricator's detail drawings showing:

Scuppers and downspouts
Flashing and counterflashing
All associated accessories

The drawings and manufacturer's product data shall indicate type of material(s) used, material profile, jointing pattern, jointing details, fastening methods, flashing, terminations, and installation details.

Samples: Submit two samples 300 mm (12") long of each type of downspouts, flashing, and accessories illustrating typical material, and finish.

**QUALIFICATIONS.**

Fabricator and Installer: Company specializing in sheet metal flashing work with 5 years minimum experience.

**DELIVERY, STORAGE AND HANDLING.**

A. Deliver, store, protect, and handle products to site under provisions of Division 1.

B. Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

## 1.7 BASIS OF PAYMENT.

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

## PART 2 – PRODUCTS:

## 2.1 MANUFACTURERS.

A. Stainless Steel Flashing Trim: Through wall, base, lintel, sill; Brake formed to required profiles.

B. Scuppers and downspouts: Stainless Steel- brake formed to required profiles.

C. Substitutions: Under provisions of Division 1.

## 2.2 SHEET MATERIALS.

A. Stainless Steel: ASTM A240, type 304, 20 gauge, architectural grade alloy, finish to be 2B.

## 2.3 ACCESSORIES AND COMPONENTS.

A. Fastener: Same material and finish as flashing metal with soft neoprene washers at exposed fasteners.

B. Underlayment: 6 mil polyethylene.

C. Slip Sheet: Rosin sized building paper.

D. Sealant: Type specified in Section 07 92 00.

E. Solder: ASTM B32; 50/50 type.

F. Flux: FS O-F-506.

G. Downspout: Stainless Steel. Fabricate to 3” x 4” rectangular profile.

H. Splash Pads: Precast concrete type: minimum 3000psi at 28 days, with minimum 5 percent air entrainment.

## 2.4 FABRICATION.

A. Form sections true to shape, accurate in size, square, and free from distortion or defects. Form scupper and downspout sections to sizes as shown on drawings. Downspout shall be rectangular 3”x4” profile.

B. Fabricate cleats, hold-down clips, and starter strips of same material as sheet, minimum 50 mm (2 inches) wide, interlockable with sheet.

C. Form pieces in longest practical lengths.

D. Hem exposed edges on underside 13 mm (1/2 inch); miter and seam corners.

E. Form material with flat lock seam.

F. Solder and seal metal joints. After soldering, remove flux. Wipe and wash solder joints clean.

G. Fabricate corners from one piece with minimum 406 mm (16 inch) long legs; solder for rigidity, seal with sealant.

H. Fabricate vertical faces with bottom edge formed outward 6.3 mm (1/4 inch) and hemmed 45 o to form drip.

I. Fabricate flashing to allow toe to extend 50 mm (2 inches) over roofing. Return and brake edges.

**PART 3 – EXECUTION:**

**3.1 EXAMINATION.**

A. Verify roof openings, pipes, or vents through roof are solidly set and nailing strips located.

B. Verify roofing termination and base flashing are in place, sealed, and secure.

**3.2 PREPARATION.**

A. Install starter and edge strips, and cleats before starting installation.

B. Field measure site conditions prior to fabricating work.

**3.3 INSTALLATION.**

A. Secure flashing in place using concealed fasteners. Use exposed fasteners only in locations approved by Engineer.

B. Lap, Cleat and seal all joints.

C. Fit flashing tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

E. Seal metal joints watertight.

F. Secure scuppers and downspouts in place using concealed fasteners where applicable.

G. Set concrete splash pads under downspouts.

## 3.4 FIELD QUALITY CONTROL.

A. Field inspection will be performed under provisions of Division 1.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

**END OF SECTION 07 62 00**

**DIVISION 7 - THERMAL AND MOISTURE PROTECTION**

**SECTION 07 92 00 - JOINT SEALERS**

**PART 1 – GENERAL:**

**1.1 SECTION INCLUDES.**

Preparing sealant substrate surfaces.

Sealant and backing.

**1.2 RELATED SECTIONS.**

Section 03 30 00 - Cast-In-Place Concrete.

Section 04 10 00 - Unit Masonry System.

Section 07 62 00 - Sheet Metal Flashing and Trim: Sealants used in conjunction with metal flashings.

Section 08 11 16 - Aluminum Doors and Frames.

Section 08 51 13 – Aluminum Windows.

Section 08 71 00 – Door Hardware.

Section 08 81 00 – Glass and Glazing.

Divisions 5, 10 through 16.

**REFERENCES.**

ASTM C804 – Use of Solvent-Release Type Sealants.

ASTM C920 - Elastomeric Joint Sealants.

ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

ASTM D1751 – Preformed Expansion Joint Filler for Concrete Paving and Structural Construction.

FS HH-F-341 _ Fillers, Expansion Joint: Bituminous

FS TT-S-00227 – Sealing Compound: Elastomeric Type, Multi-Component.

FS TT-S-001543 - Sealing Compound, Silicone Rubber Base.

SWRI (Sealing, Waterproofing, and Restoration Institute) - Sealant and Caulking Guide Specification.

## 1.4 SUBMITTALS.

A. Submit under provisions of Division 1.

B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

C. Samples: Submit two samples 102 mm x 13 mm (4 x 1/2 inches) in size illustrating color for selection.

D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

## 1.5 QUALITY ASSURANCE.

A. Perform work in accordance with SWRI requirements for materials and installation.

## 1.6 QUALIFICATIONS.

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.

B. Applicator: Company specializing in performing the work of this section with minimum 5 years documented experience.

## 1.7 ENVIRONMENTAL REQUIREMENTS.

A. Do not install solvent curing sealants in enclosed building spaces without providing adequate ventilation.

B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

## 1.8 COORDINATION.

A. Coordinate work under provisions of Division 1.

B. Coordinate the work with all sections referencing this section.

## 1.9 BASIS OF PAYMENT.

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

**PART 2 – PRODUCTS:**

**2.1 SEALANTS.**

A. Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25 (100/50), Use NT, M, G, A, O; single component, moisture curing, low modulus type; colors to be selected by Engineer from manufacturer's standard color selection (see schedule below); product: Spectrem 1 manufactured by Tremco. Color Schedule:

1. Exterior wall joints: match mortar joint color.
2. Sheet metal coping: match sheet metal color
3. Exterior doors: match stainless steel color.
4. Exterior louvers, etc: match louver, equipment color(s)
5. Other surfaces: match substrate color as approved by Engineer

**2.2 ACCESSORIES.**

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

E. Bituminous and Fiber Joint Filler: ASTM D1751 or FS HH-F-341.

**PART 3 – EXECUTION:**

**3.1 EXAMINATION.**

A. Verify that substrate surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.

B. Verify that joint backing and release tapes are compatible with sealant.

**3.2 PREPARATION.**

A. Remove loose materials and foreign matter which might impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with ASTM C804 for solvent release sealants.

D. Protect elements surrounding the work of this section from damage or disfiguration.

## 3.3 INSTALLATION.

A. Install sealant in accordance with manufacturer's instructions.

B. Measure joint dimensions and size materials to achieve required width/depth ratios.

C. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.

D. Install bond breaker where joint backing is not used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Tool joints concave.

## 3.4 CLEANING AND REPAIRING.

A. Clean work under provisions of Division 1.

B. Clean adjacent soiled surfaces.

C. Repair or replace defaced or disfigured finishes caused by work of this Section.

## 3.5 PROTECTION OF FINISHED WORK.

A. Protect finished installation under provisions of Division 1.

B. Protect sealants until cured.

**END OF SECTION 07 92 00**

**DIVISION 8 - DOORS AND WINDOWS**

**SECTION 08 13 19 – STAINLESS STEEL DOORS AND FRAMES**

**PART 1 – GENERAL:**

**1.1 SECTION INCLUDES.**

A. Stainless steel doors.

B. Stainless steel frames.

C. Steel window frames.

**1.2 RELATED SECTION.**

A. Section 04 10 00 - Unit Masonry.

B. Section 05 50 00 - Metal Fabrications.

C. Section 08 71 00 - Door Hardware.

D. Section 08 81 00 – Glass and Glazing.

**1.3 REFERENCES.**

A. ANSI A250.6 – Hardware Reinforcing on Standard Steel Doors and Frames.

B. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

C. ANSI/SDI A250.11 – Recommended Erection Instructions for Steel Frames

D. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware

E. ASTM A510 – Standard Specification for General Requirements for Wire Rods and Course Round Wire, Carbon Steel.

F. ASTM 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 Hardened.

G. ANSI/ASTM A568 – Standard Specification for Steel Sheet, Carbon, and High Strength Low Alloy Hot Rolled and Cold Rolled Sheet Steel.

H. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanealed) by the Hip Dip Process.

I. DHI A115.1G – Door Hardware Institute, Installation Guide for Doors and Hardware.

J. SDI 117 – Steel Door Institute, Manufacturing Tolerances for Steel Doors and Frames.

K. SDI 22 – Installation and Troubleshooting Guide for Standard Steel Doors and Frames.

## 1.4 SUBMITTALS.

A. Submit under provisions of Division 1.

B. Shop Drawings: In addition to requirements below, provide a schedule of doors and frames using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details.
3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of glazing frames and stops showing glazing and glazing requirements.
8. Fire-resistance ratings.

C. Manufacturer's Installation Instructions: Indicate special installation instructions.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

## 1.5 QUALIFICATIONS.

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

## 1.6 QUALITY ASSURANCE.

A. Steel Door and Frame Standard: Comply with ANSI A250.8 unless more stringent requirements are indicated.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

## 1.7 DELIVERY, STORAGE AND PROTECTION.

A. Deliver, store, protect and handle products to site under provisions of Division 1.

B. Deliver doors and frames cardboard wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory finished doors and frames.

C. Inspect doors and frames on delivery for damage and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new

work and are acceptable to Engineer. Remove and replace damaged items that cannot be repaired as directed.

D. Store doors and frames at building site under cover. Place units on minimum 4-inch high wood blocking. Avoid using nonvented plastic or canvas that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum ¼ inch spaces between stacked doors to permit air circulation.

## 1.8 BASIS OF PAYMENT.

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

## PART 2 – PRODUCTS:

## 2.1 MANUFACTURERS.

A. Ceco Door Products.

B. Steelcraft.

C. Curries Company

D. Substitutions: Under provisions of Division 1.

## 2.2 MATERIALS.

A. Stainless Steel: ASTM A240, Type 304.

B. Door Core:

1. Stiffened: Continuous vertical formed stainless steel sections, 0.026 in. (0.6 mm) minimum thickness, spaced with interior webs not more than 6 in. (152 mm) apart, which upon assembly, span the full thickness of the interior of the door. Voids between stiffeners shall be filled with fiberglass or mineral rock-wool batt-type material.

## 2.3 DOORS AND FRAMES.

A. Doors: Level 2 Heavy Duty 1-3/4 inches thick, seamless construction (i.e.: Level II, Model 2).

B. Doors and Frames: Face sheet construction. (Level II, Model 2) Heavy Duty 0.053 inch minimum wall thickness for both door and frame construction.

C. Frames: shall be full profile weld type; provide minimum of three anchors per jamb suitable for adjoining wall construction. Provide anchors of not less than 0.042 inch in thickness or 0.167 inch diameter wire. Frames over 7’-6” shall be provided with an additional anchor per jamb.

D. Frames: Base anchors shall be provided with minimum thickness of 0.042 inches.

E. All frames shall be fully prepared for all mortise template hardware and reinforced only for surface mounted hardware. Drilling and/or tapping shall be completed by others.

F. Minimum hardware reinforcing gages shall comply with Table 4 of ANSI/SDI A250.8.

G. Fire rated door assemblies: Materials and construction shall comply with NFPA 80 requirements.

## 2.4 ACCESSORIES, SUPPORTS AND ANCHORS.

A. Wall anchors in masonry construction: 0.177 inch diameter, steel wire complying with ASTM A510 may be used in place of steel sheet.

B. Inserts, Bolts and Fasteners: Manufacturer's standard units.

C. Exterior Top Caps: Stainless steel flush channel.

D. Frame Thermal Breaks: Rigid polyvinylchloride extrusion.

## 2.5 FABRICATION.

A. Fabricate doors and frames to comply with ANSI/SDI 250.8 and to be rigid, neat in appearance, and free form defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project Site.

B. Stainless Steel Doors: 1.6 mm (16 guage) thick stainless steel door faces.

C. Flush Design: Non-fire rated.

1. Flush Design: Butt seam door construction, longitudinal edges fully welded with no visible edge seam.
2. Top and Bottom Channels: Inverted, recessed, welded steel channels.
3. Astragals: Stainless steel Z shaped astragals for double doors.
4. Exterior Door: Flush stainless steel top caps.
5. Fabricate with stainless steel hardware reinforcement plates welded in place
6. Core: Stiffened.

D. Stainless Steel Frames:

1. Stainless Steel Frames: 2.0 mm (14 gauge) thick stainless steel, welded type construction, mitred corners.
2. Factory assemble and weld stainless steel frames.
3. Stainless Steel Mullions for Double Doors: Removable type.
4. Fabricate with stainless steel hardware reinforcement plates welded in place.

5. Reinforce frames wider than 1200 mm (48 inches) with roll formed stainless steel channels fitted tightly into frame head, flush with top.

E. Tolerances: Comply with SDI 117.

F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

G. Hardware Preparation:

1. Prepare doors and frames to receive mortised and concealed hardware according to door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
2. For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.

H. Frame Construction:

1. Fabricate frames, including transom, sidelight frame, etc. to shape or configuration shown.
2. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints.
3. Provide temporary spreader bars.

I. Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface applied hardware may be done at project site.

J. Locate hardware as indicated on Shop Drawings, or, if not indicated, according to ANSI A250.8.

K. Fabricate frames with 4 inch head member or as indicated.

**2.6 FINISH.**

A. Standard Stainless Steel Finish: #2B Mill Finish.

**PART 3 – EXECUTION:**

**3.1 EXAMINATION.**

A. Verify that opening dimensions and tolerances are acceptable.

**3.2 INSTALLATION.**

A. General: Install doors, frames, glazing and hardware in accordance with Shop Drawings, manufacturer's instructions, and as specified.

B. Placing Frames:

1. Comply with provisions in ANSI/SDI A250.1 unless otherwise indicated.
2. Set frames accurately in position, plumbed, aligned and braced securely until permanent anchors are set.
3. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
4. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
5. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.

C. Door Installation:

1. Comply with ANSI A250.8 unless otherwise indicated.
2. Fit hollow metal doors accurately in frames within tolerances specified in ANSI A250.8.
3. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Hardware: Install hardware using templates provided. Refer to Section 8D for hardware installation requirements.

## 3.3 TOLERANCES.

A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

## 3.4 ADJUSTING AND CLEANING.

A. Adjust work under provisions of Division 1.

B. Adjust door for smooth and balanced door movement.

C. Protection Removal: Immediately before final inspection, remove protective material or wrappings from doors and frames where applicable.

D. Wash down exposed surfaces using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

## 3.5 SCHEDULE.

A. See Drawings and refer to Shop Drawings.

**END OF SECTION 08 13 19**

**DIVISION 8 – OPENINGS**

**SECTION 08 33 36 – OVERHEAD COILING DOORS**

**PART 1 - GENERAL:**

**1.1 SECTION INCLUDES.**

A. Overhead coiling service doors.

**1.2 RELATED SECTIONS.**

A. Section 05 50 00 - Metal Fabrications.

B. Section 09 91 00 - Painting and Coating.

C. Section 26 05 00 - Common Work Results for Electrical.

**1.3 REFERENCES.**

A. ANSI/DASMA 108 - American National Standards Institute Standard Method For Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.

B. NFRC 102 - Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.

C. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.

D. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

E. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

G. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

H. NEMA MG 1 - Motors and Generators.

**1.4 DESIGN / PERFORMANCE REQUIREMENTS.**

A. Overhead coiling service doors:

1. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa) without damage to door or assembly components in conformance with ASTM E 330.

2. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.

B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

## 1.5 SUBMITTALS.

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Details of construction and fabrication.

4. Installation instructions.

C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

## 1.6 QUALITY ASSURANCE.

A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.

B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

**1.7 DELIVERY, STORAGE, AND HANDLING.**

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated weathertight location.

**1.8 PROJECT CONDITIONS.**

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

**1.9 COORDINATION.**

A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

**1.10 WARRANTY.**

A. Warranty: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.

B. Warranty: Manufacturer's limited door system warranty for 2 years for all parts and components.

**PART 2 - PRODUCTS:**

**2.1 MANUFACTURERS.**

A. Acceptable Manufacturer: Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: arcat@overheaddoor.com.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

**2.2 OVERHEAD COILING SERVICE DOORS.**

A. Industrial Doors: Overhead Door Corporation, Model 610 Service Doors.

1. Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.

a. Flat profile type F-265 for doors up to 18 feet 4 inches (5.59 m) wide, fabricated of:

1) 20 gauge stainless steel.

2. Slats and Hood Finish:

a. Stainless Steel: Slats and hood shall be stainless steel finished as follows.

1) Finish: 2B mill finish.

3. Weatherseals:

a. Vinyl bottom seal.

4. Bottom Bar:

a. Two galvanized steel angles.

5. Guides: Three structural steel angles.

6. Brackets:

a. Galvanized steel to support counterbalance, curtain and hood.

7. Finish; Bottom Bar, Guides, Headplate and Brackets:

a. Finish: Black powdercoat finish.

8. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.

9. Hood:

a. Stainless steel, 24 gauge hood with intermediate supports as required.

10. Manual Operation:

a. Chain hoist for doors over 96 SF.

11. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than

2/3 foot nor more than 1 foot per second.

a. Sensing Edge Protection:

1) Pneumatic sensing edge.

b. Operator Controls:

1) Push-button operated control stations with open, close, and stop buttons.

2) Controls for interior location.

3) Controls surface mounted.

c. Motor Voltage: 115/230 single phase, 60 Hz.

12. Windload Design:

a. Standard windload shall be 20 PSF.

13. Locking:

a. Interior slide bolt lock for electric operation with interlock switch.

14. Wall Mounting Condition:

a. Face-of-wall mounting.

**PART 3 - EXECUTION:**

**3.1 EXAMINATION.**

A. Verify opening sizes, tolerances and conditions are acceptable.

B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

**3.2 PREPARATION.**

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

**3.3 INSTALLATION.**

A. Install in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 26 05 00 – Common Work Results for Electrical. Complete wiring from disconnect to unit components.

F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00 – Joint Protection.

G. Install perimeter trim and closures.

H. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

**3.4 ADJUSTING.**

A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.

B. Adjust hardware and operating assemblies for smooth and noiseless operation.

**3.5 CLEANING.**

A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.

B. Remove labels and visible markings.

C. Touch-up, repair or replace damaged products before Substantial Completion.

**3.6 PROTECTION.**

A. Protect installed products until completion of project.

**END OF SECTION 08 33 36**

**DIVISION 8 - DOORS AND WINDOWS**

**SECTION 08 71 00 - DOOR HARDWARE**

**PART 1 – GENERAL:**

**1.1 SECTION INCLUDES.**

A. Hardware for aluminum and steel doors.

B. Fire rated hardware for fire-rated doors.

C. Thresholds.

D. Weatherstripping.

**1.2 RELATED SECTIONS.**

A. Section 04 10 00 - Unit Masonry.

B. Section 05 50 00 - Metal Fabrications.

C. Section 08 11 16 - Aluminum Doors and Frames.

D. Section 08 51 13 – Aluminum Windows.

**1.3 REFERENCES.**

A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

B. BHMA - Builders' Hardware Manufacturers Association.

C. DHI - Door and Hardware Institute.

D. NAAMM - National Association of Architectural Metal Manufacturers.

E. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

F. UL 305 - Panic Hardware.

**1.4 SUBMITTALS.**

A. Submit under provisions of Division 1.

B. Shop Drawings: Indicate locations and mounting heights of each type of hardware.

C. Submit manufacturer's parts lists, templates.

D. Product Data: Provide data on specified hardware.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

**1.5 PROJECT RECORD DOCUMENTS.**

A. Submit under provisions of Division 1.

B. Record actual locations of installed cylinders and their master key code.

**1.6 OPERATION AND MAINTENANCE DATA.**

A. Submit under provisions of Division 1.

B. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

**1.7 QUALITY ASSURANCE.**

A. Perform work in accordance with the following requirements:

1. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

2. NFPA 101.

**1.8 QUALITY ASSURANCE.**

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

B. Hardware Supplier: Company specializing in supplying commercial door hardware with 5 years documented experience.

C. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC), as certified by the Door and Hardware Institute to assist in the work of this section.

**1.9 REGULATORY REQUIREMENTS.**

A. Conform to applicable code for requirements applicable to fire rated doors and frames.

**1.10 DELIVERY, STORAGE, AND HANDLING.**

A. Deliver, store, protect, and handle products to site under provisions of Division 1.

B. Package hardware items individually; label and identify package with door opening code to match hardware schedule.

C. Deliver keys to Owner by security shipment direct from hardware supplier.

D. Protect hardware from theft by cataloging and storing in secure area.

**1.11 COORDINATION.**

A. Coordinate work with other directly affected Sections involving manufacturer or fabrication of internal reinforcement for door hardware.

**1.12 WARRANTY.**

A. Provide five year warranty under provisions of Division 1.

B. Warranty: Include coverage of door closures.

**1.13 MAINTENANCE MATERIALS.**

A. Provide maintenance materials under provisions of Division 1.

B. Provide special wrenches and tools applicable to each different or special hardware component.

C. Provide maintenance tools and accessories supplied by hardware component manufacturer.

**1.14 BASIS OF PAYMENT.**

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

**PART 2 – PRODUCTS:**

**2.1 MANUFACTURERS.**

A. Exit Devices (Rim Type): Corbin Russwin, Adams Rite, Von Duprin.

B. Exit Devices (Vertical Rod Type): Corbin Russwin, Adams Rite, Von Duprin.

C. Mortise Lockset: Corbin Russwin, Schlage, and Yale.

D. Mortise Latchset: Corbin Russwin, Schlage, and Yale.

E. Dummy Trim: Corbin Russwin, Schlage and Yale.

F. Hinges: Hager, Stanley, and Lawrence.

G. Closers: Corbin Russwin, LCN, and Norton.

H. Flush Bolts: Corbin Russwin, Hager, Rockwood, Baldwin, Ives.

I. Weatherstripping: National Guard Products, Hager, Penko, Reese Enterprises.

J. Thresholds: National Guard Products, Hager, Pemko, Reese Enterprises.

K. Astragals: National Guard Products, Reese Enterprises, Pemko.

L. Door Sweeps: National Guard Products, Pemko.

M. Kick plates: National Guard Products, Hiawatha, Ives, Brookline, Rockwood.

N. Wall stops: Ives, Rockwood.

O. IDOT Standard Surface Mounted Outside Deadbolt: American Lock

P. Substitutions: Under provisions of Division 1.

**2.2 KEYING.**

A. Supply 5 keys for each lock.

B. Keys shall match Owner's keying system.

C. Serial numbers shall be stamped or engraved on all keys.

**2.3 FINISHES.**

A. Finishes: Identified in schedule at end of section.

**PART 3 – EXECUTION:**

**3.1 EXAMINATION.**

A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

**3.2 INSTALLATION.**

A. Install hardware in accordance with manufacturer's instructions and requirements of NAAMM.

B. Use templates provided by hardware item manufacturer.

C. Conform to ANSI A117.1 for positioning requirements for the handicapped.

**3.3 FIELD QUALITY CONTROL.**

A. Field inspection will be performed under provisions of Division 1.

B. Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

C. Provide two copies of certification to Engineer.

## 3.4 PROTECTION OF FINISHED WORK.

A. Protect finished work under provisions of Division 1.

B. Do not permit adjacent work to damage hardware or finish.

## SCHEDULE.

A. General: Provide fire-rated hardware to match B-label door and frame as required to provide a fully operational fire-rated door assembly. Refer to drawings for designated door.

B. Exit Devices: Rim Type-Single Leaf Door) Heavy Duty, visible parts US 32D finish, nonferrous internal parts, surface mounted rim type with ¾" throw on latch bolt. Keyed access with trim lever handle mounted on exterior side of door leaf.

| | | |
|---|---|---|
| 1. | Corbin Russwin | Model ED5200 |
| 2. | Adams Rite | Model 8300 |
| 3. | Von Duprin | Model CRE |

C. Exit Devices: (Vertical Rod Type-Active Leaf Door of Double Doors) Heavy Duty, visible parts US 32D finish, nonferrous internal parts, surface mounted vertical rods with two point latching on active leaf. Keyed access with trim lever handle mounted on exterior side of active door leaf. Corbin Russwin ED 5400 Series.

| | | |
|---|---|---|
| 1. | Corbin Russwin | Model No. ED5400 |
| 2. | Adams Rite | Model 8100 |
| 3. | Von Duprin | Model CRE |

D. Mortise Lockset (Entrance Type): Wrought bronze, visible parts US32D finish, non-ferrous internal parts, with minimum 3/4" throw on latch bolt, 1" throw on deadbolt. Cylinder shall be as specified by Owner. Latch bolt by grip either side. Dead bolt by key outside or by thumbturn lever inside, inside grip simultaneously retracts latchbolt and deadbolt

| | | |
|---|---|---|
| 1. | Corbin Russwin | Model ML2048 x LSM |
| 2. | Schlage | Model L9453x03 |
| 3. | Yale | Model 8847 CRE |

E. Dummy Trim Lockset x Lever Action: (No lever on inside face) Heavy Duty, visible parts US 32D finish, nonferrous internal parts, surface mounted rim type with ¾" throw on latch bolt. Keyed access with trim lever handle mounted on exterior side of door leaf.

| | | |
|---|---|---|
| 1. | Corbin Russwin | Model LSM |
| 2. | Schlage | Model L9176x03 |
| 3. | Yale | Model CRE |

F. Hinges: Stainless steel, heavy weight, five knuckle, four ball bearing with non-rising pin, button tip and ring, non-removable stainless steel pin on exterior doors, US32D finish. (All doors to open 180 degrees)

1. Door size to 8'-0" x 4'-0" 2 pr. 4.5" x 4.5".

| | | |
|---|---|---|
| a. | Hager | Model BB1199. |
| b. | Stanley | Model FBB 191 |
| c. | Lawrence | Model BB4101 |

G. Closers: Heavy duty parallel arms with adjustable closing speed, with hold-open for outswinging exterior doors. US32D finish. (All doors to open 180 degrees)

| | | |
|---|---|---|
| 1. | Corbin Russwin | Model DC6000 Series (DC6210 A2 M72) |
| 2. | LCN | Model 4010/4110 Smoothe Series |
| 3. | Norton | Model 7500 Series |

H. Flush Bolts: US32D (satin stainless steel finish), full mortised extension flush bolts with dust proof strike, located at inactive leaf of all pairs of doors. Corbin Russwin Model 2849 with No. 70-1/2M Strike.

| | | |
|---|---|---|
| 1. | Corbin Russwin | Model 2849 W/ No. 70-1/2M Strike |
| 2. | Hager | Model 282D x 26D |
| 3. | Rockwood | Model 555 x 26D |
| 4. | Baldwin | Model 0600 x 26D |
| 5. | Ives | Model FB458 X 26D |

I. Weatherstripping: Head and jamb gasket, aluminum with clear anodized aluminum finish and neoprene insert.

| | | |
|---|---|---|
| 1. | National Guard Products | Model 110 NA |
| 2. | Hager | Model 412S x AL |
| 3. | Pemko | Model 332 CR |
| 4. | Reese Enterprises | Model DS 69C |

J. Thresholds: Heavy Duty, clear anodized aluminum finish, with chemically treated stainless steel screws, set in full bed of sealant. 5" x 12". Thermally broken.

| | | |
|---|---|---|
| 1. | National Guard Products | Model 8425 x AL |
| 2. | Hager | Model 412S x AL |
| 3. | Pemko | Model 252 x 3AFG x AL |
| 4. | Reese Enterprises | Model S282A x AL |

K. Astragals: Full height, clear anodized aluminum, surface mounted, meeting stile gasketing with silicone seal.
   1. Doors with one active leaf:
      a. National Guard Products Model 109NA
      b. Reese Enterprises Model 93C
      c. Pemko Model 375CR

L. Door Sweep: Nylon brush gasketing, clear aluminum finish.

   1. National Guard Products Model 600A
   2. Pemko Model 18137CNB

M. Kick Plate: Ives Model 8400 10”x34” US32D x 16GA, or equal selected from manufacturers listed below.

   1. National Guard Products
   2. Hiawatha
   3. Ives
   4. Brookline
   5. Rockwood

Exit Doors are not Pad Lockable.

**HARDWARE SCHEDULE PER DOOR.**

A. Door Hardware Req’d

   1. D1(exterior door) Exit Device (rim type) with keyed access and lever trim exterior side, hinges, weatherstripping, door sweep, closer, IDOT Std. Deadbolt, threshold, kick plate.

   2. D2(exterior double door) Exit Device (vertical rod type) on active leaf with keyed access and lever trim exterior side, dummy trim inactive leaf, hinges, weatherstripping, door sweep each door, two closers, threshold, flush bolts on inactive leaf, astragal on active leaf, IDOT Std. Deadbolt, kick plates on each door leaf.

   3. D3(interior attic door).

**END OF SECTION 08 71 00**

**DIVISION 8 - DOORS AND WINDOWS**

**SECTION 08 81 00 - GLASS AND GLAZING**

**GENERAL:**

**SECTION INCLUDES.**

Glass and glazing for steel window assemblies.

**RELATED SECTION.**

Section 08 13 19 – Stainless Steel Doors and Frames.

**REFERENCES.**

ANSI Z97.1 – Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

ASTM D1667 – Standard Specification for Flexible Cellular Materials – Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).

ASTM D2000 – Standard Classification System for Rubber Products in Automotive Applications.

ASTM D2287 – Standard Specifications for Non-rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

ASTM E84 – Surface Burning Characteristics of Building Materials.

FS DD-G-451 – Glass, Float or Plate, Sheet, Figured (Flat, for Glazing, Mirrors, and Other Uses).

FS DD-G-1403 – Glass, Plate (Float), Sheet, Figured, and Spandrel (Heat Strengthened & Fully Tempered).

FGMA – Glazing Manual. Glazing Sealing Systems Manual.

**SUBMITTALS.**

Submit under provisions of Division 1.

Shop Drawings: In addition to requirements below, provide a schedule glazing size and type for each frame using same reference numbers for details and openings as those on Drawings:
Elevations of each window.
Details of glazing frames and stops showing glazing and glazing requirements.

Manufacturer's Data: Glass:

Manufacturer’s specifications and installation instructions for each type of glass required.
Include test data substantiating that glass complies with specified requirements.

Manufacturer’s Data: Glazing Materials:

Manufacturer’s specifications and installation instructions for each type of glazing sealant and compound, gasket and associated miscellaneous material. Include manufacturer’s published data, or letter of certification, or certified test laboratory report indicating that each material complies with project specifications and is suitable for the applications shown.

Samples: Glass:

Submit 3, samples of each type of glass specified.
Insulating glass samples need not be hermetically sealed, but edge construction shall be included.

A. Manufacturer's Installation Instructions: Indicate special installation instructions.
B. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

**QUALIFICATIONS.**

Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

**QUALITY ASSURANCE.**

Conform to Flat Glass Marketing Association (FGMA) Glazing Manual for glazing installation methods.

A. Provide ten year manufacturer’s warranty under provisions of Division 1.

**DELIVERY, STORAGE AND PROTECTION.**

A. Deliver, store, protect and handle products to site under provisions of Division 1.

B. Deliver glass and glazing to window manufacturer in accordance with each manufacturer’s instructions. Protect in cardboard wrapped containers, crated, or other manufacturer’s protection method to provide protection during transit and job storage. Provide additional protection to prevent damage to glass and glazing.

C. Remove and replace damaged items that cannot be repaired as directed.

**BASIS OF PAYMENT.**

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, PUMP STATION GENERAL WORK.

**PRODUCTS:**

**MANUFACTURERS.**

A. PPG Industries, Inc.

B. Libby-Owens-Ford Co. (A Pilkington Glass Company)

C. AFG Industries. (AGC Flat Glass North America)

D. Substitutions: Under provisions of Division 1.

**GLASS MATERIALS.**

A. Type G1: ¼" thick, clear, fully tempered, safety glass.

**GLAZING SEALANTS/COMPOUNDS.**

A. Preformed Butyl Rubber Glazing Sealant.

1. Tape or ribbon (coiled on release paper) of polymerized butyl, of mixture of butyl and polyisobutylene, compounded with inert fillers and pigments, solvent based with minimum of 95% solids, with thread of fabric reinforcement, tack-free within 24 hours, paintable, non-staining.

2. Provide combination tape and encased continuous rubber shim, of approximately 50 durometer hardness.

3. Any caulkings or window sealants which come in contact with the insulating glass sealants are to be compressible.

**GLAZING GASKETS.**

A. Provide glazing gaskets recommended by manufacturer.

B. Miscellaneous Glazing Materials

1. Settling Blocks: Neoprene, 70-90 durometer hardness with proven compatibility with sealants used.

2. Spacers: Neoprene 40-50 durometer hardness, with proven compatibility with sealants used.

3. Compressible Filler Rod: Closed cell or waterproof jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 510 psi compression strength for 25% deflection.

4. Cleaners, Primers, and Sealants: Type recommended by sealant or gasket manufacturer.

**EXECUTION:**

**EXAMINATION.**

A. Verify that opening dimensions and tolerances are acceptable.

B. Examine the framing and glazing surfaces, backing, and removable stop design, and the conditions under which the glazing will be installed on the doors.

C. Do not proceed with glazing until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer, and in accordance with specifications.

**JOB REQUIREMENTS AND INSTALLATION.**

A. General: Install glass and glazing in accordance with Shop Drawings, manufacturer's instructions, and as specified.

B. Coordinate installation of glass and framing with window manufacturer.

C. Provide watertight and airtight installation of each piece of glass. Each installation shall withstand normal temperature changes, wind loading, impact loading for doors, without failure of any kind including loss or breakage of glass, failure of sealants, or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.

D. Protect glass at all times during handling, installation and operation of the building.

E. Glazing dimensions shown provide for a minimum bite on the glass: minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. Be responsible for correct glass size for each opening, within tolerance for the dimensions established.

F. Comply with combined recommendations of glass manufacturer, manufacturer of sealants, manufacturer of windows and other materials used in glazing except where more stringent requirements are shown or specified, and except where manufacturer’s technical representatives direct otherwise. Installation shall meet or exceed window manufacturer’s requirements.

G. Inspect each piece of glass immediately before installation, and eliminate all which have observable edge damage or face imperfections.

**GLAZING.**

A. Prepare and clean framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.

B. Comply with ANSI Standard Z97.1-2004 Safety Glazing Code.

C. Install setting blocks of proper size at quarter points. Set blocks in thin course of the heelbead compound.

D. Glazing shall be set with equal bearing for entire width.

E. Provide minimum 1/8 inch bite of spacers on glass and use thickness equal to sealant width. Where sealant tape is used instead, use thickness slightly less than final compressed tape thickness.

F. Voids and Filler Rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in the channels at the heel of jambs and head (do not leave voids in the sill channels) except as otherwise indicated, depending on light size, thickness and type of glass and complying with manufacturer's recommendations.

G. Do not attempt to cut, seam, nip or abrade glass which is chemically strengthened, tempered, or heat strengthened.

H. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

I. Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from the glass. Install pressurized tapes and gaskets to protrude slightly out of the channel to eliminate dirt and moisture products.

J. Clean and trim excess glazing materials from the glass and stops or frames promptly after installation, and eliminate stains and discolorations.

K. Where wedge shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure that the gasket will not "walk" out when subjected to dynamic movement. Anchor gasket to stop with matching ribs, or proven adhesive, including embedment of gasket tail in cured heel bead.

**CURE, PROTECTION, ADJUSTING AND CLEANING.**

A. Adjust work under provisions of Division 1.

B. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

C. Protect glass from breakage or damage during installation of window assembly. Do not apply markers to any type of glass surface.

D. Remove and replace glass which is broken, chipped, cracked, abraded, or damaged in other ways during the construction period, including natural causes, accidents and vandalism.

E. Wash and polish glass on both sides not more than four days prior to acceptance of the work. Comply with glass manufacturer's recommendations. Washing shall be done in accordance with manufacturer's instructions.

**SCHEDULE.**

A. See Drawings and refer to Shop Drawings.

**END OF SECTION 08 81 00**

**DIVISION 8 - OPENINGS**

**SECTION 08 90 00 - LOUVERS AND VENTS**

**GENERAL:**

1. **SUMMARY.**

B. Section Includes:

1. Fixed, extruded-aluminum wall louvers.
2. Wall vents (brick vents).

C. See Division 8 Section "Steel Doors and Frames" for louvers in hollow-metal doors.

D. See Division 8 Section "Flush Wood Doors" for louvers in flush wood doors.

E. See Division 15 Sections for louvers that are a part of mechanical equipment.

**PERFORMANCE REQUIREMENTS.**

F. Design: Design louvers, including comprehensive engineering analysis by a qualified engineer, using structural performance requirements and design criteria indicated.

G. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

1. Wind Loads: Determine loads based on a uniform pressure of 30 lb./sq. ft. (1435 Pa), acting inward or outward.

H. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

**SUBMITTALS.**

I. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

J. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

K. Samples: For each type of metal finish required.

L. Submittal: For louvers indicated to comply with structural performance requirements and design criteria indicated.

M. Product Test Reports: Based on tests performed according to AMCA 500-L.

**PRODUCTS.**

MATERIALS

N. Aluminum Extrusions: ASTM B 221M, Alloy 6063-T5.

O. Aluminum Sheet: ASTM B 209M, Alloy 3003 with temper as required for forming.

P. Fasteners: Use types and sizes to suit unit installation conditions.

1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

**FABRICATION, GENERAL.**

Q. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

R. Join frame members to each other and to fixed louver blades with fillet welds concealed from view welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

**FIXED, EXTRUDED-ALUMINUM LOUVERS.**

S. Horizontal Drainable-Blade Louver

1. Basis-of-Design Product: Subject to compliance with requirements, provide the specified product or comparable product by one of the following:
   a. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 - Product Substitution Procedures.

2. Louver Depth: 4 inches (100 mm)
3. Blade Profile: Drainable blade with front gutter for water diversion to jambs
4. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm) for blades and frames.
5. Louver Performance Ratings:

   a. Free Area: Not less than 8.96 sq. ft. (0.83 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
   b. Point of Beginning Water Penetration: Not less than 930 fpm (4.7 m/s).
   c. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 800 fpm (4.1-m/s) free-area velocity.

d. Air Performance: Not more than 0.15-inch wg (37-Pa) static pressure drop at 1000-fpm (5.1-m/s) free-area velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

**LOUVER SCREENS.**

T. General: Provide screen at each exterior louver.

U. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.

V. Louver Screening: Same kind of metal as indicated for louver.

1. Insect Screening: Aluminum, 16 x 18 square mesh, 0.011-inch (0.28-mm) wire.
2. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch (19 by 1.27 mm) thick.

**ALUMINUM FINISHES.**

W. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

**EXECUTION:**

**INSTALLATION.**

X. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

Y. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

Z. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

AA. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

BB. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

**END OF SECTION 08 90 00**

**DIVISION 9 - PAINTING**

**SECTION 09 91 00 - PAINTING**

**PART 1 – GENERAL:**

**1.1 DESCRIPTION.**

A. This item of work includes the furnishing, preparation and application of painting and related items to complete the work indicated on drawings and described in these specifications.

B. All work under this Section shall be subject to the applicable provisions of Section 100 of the Standard Specifications. Refer to Division 1 for additional requirements.

C. Terms used in this Section shall be as defined in ANSI/ASTM DIG.

**1.2 REFERENCE STANDARDS.**

A. The work shall be in conformance with the applicable standards/regulations of:

1. Society of Protective Coatings.

2. National Fire Protection Association (NFPA.

3. American National Standards Institute (ANSI.

4. Occupational Safety and Health Act (OSHA.
5. SSPC SP10 "Near White Metal Blast Cleaning", Society of Protective Coatings.

6. Military Specification MIL-L-81352A.

7. Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction.

A. The term "finishes" as used herein means all painting and coating systems materials, including primers, emulsions, enamels, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

B. Consult the specifications for work and materials of other trades to determine the provisions regarding their finishing. Surfaces left unfinished by the requirements of other specifications shall be painted or finished as part of this work. Work requiring finish and not specified shall be finished same as specified for similar work. Finishing specified hereinafter shall be in addition to shop and prime coats specified in other sections.

C. The work under this section shall be done by a firm with not less than 5 years of experience in commercial painting and finishing. Documentation of this experience shall be included together with the product data submitted for approval.

**1.3 QUALITY ASSURANCE.**

A. Painting shall conform to applicable Section 1008, PAINT MATERIALS and MIXED PAINTS, of the IDOT Standard Specifications.

B. The types of paint products to be used in the work shall be identified by the manufacturer's name and number.

C. The products of manufacturers other than those herein named, which are approved equal to the products specified, may be substituted, except that, all paints applied to a surface shall be products of one manufacturer. Data showing equivalent performance of each paint product to be submitted for review at least 30 calendar days before the painting is to begin, and no painting shall proceed until the substituted products have been accepted.

D. All paints and painting materials shall be delivered to the work in the original and unopened containers plainly marked with the name, brand, shelf life, and analysis of the product, and the name of the manufacturer.

## 1.4 DELIVERY AND STORAGE OF MATERIALS.

A. Deliver materials in original containers with seals unbroken and labels intact. Do not deliver or store on the site materials other than those approved for use. Empty containers shall have labels canceled.

B. Store materials outside the building. Keep storage place neat and clean and correct all damage thereto or to its surroundings.

C. Materials shall not be mixed or applied in any room having finished floor installed without providing adequate protection. Only materials used during the course of one day may be kept within the building. Remove oily rags and waste from building every night and take every precaution to avoid danger of fire.

## 1.5 SUBMITTALS.

A. Submit product data under provisions of Section 1A.

## 1.6 SHOP DRAWINGS: SUBMIT THE FOLLOWING FOR APPROVAL.

A. Copies of manufacturer's technical information, including paint label analysis and application instructions, certification of coating, primer and finish coat for the material and service for each coating system proposed for use.

B. Copies of Contractor's proposed surface preparation and work area protection procedures in each area of the work.

C. List each material and cross-reference to the specific paint and finish system and application. Identify by manufacturer's catalog number and general classification.

D. Copies of manufacturer's complete color charts for each coating system.

## 1.7 BASIS OF PAYMENT.

A. The work shall be paid as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for the work described herein.

**PART 2 – PRODUCTS:**

**2.1 MANUFACTURERS.**

A. Tnemec Co., Inc.

B. Substitutions: Under provisions of Division 1.

**2.2 COLORS.**

A. Unless otherwise indicated, colors will be selected by the Engineer during the submitted review process.

B. Complete color charts shall be submitted of proposed paint manufacturers to the Engineer for final paint color selections.

C. Unless otherwise indicated, all surfaces without a final finish color shall be painted. In general, colors will be differentiated as follows:

1. Ceiling.
2. Grade floor.
3. Lower level floors.
4. Lower level concrete walls.
5. Interior metal trim.
6. Exterior metal trim (excluding louvers, stainless steel, and aluminum framing).
7. Exterior piping and appurtenances (such as sluicegate stands and operators).
8. Natural or anodized aluminum surfaces shall not be painted. Surfaces and equipment which are provided with a factory final finish shall not be painted.
9. Stainless steel surfaces shall not be painted unless noted otherwise.
10. Exterior concrete walls of building.
11. Interior concrete walls of building (including masonry surfaces that are not glazed block surfaces).
12. Safety items as necessary (bollards, hoist beams/trolley, etc.).

D. Notes:

1. Wall and floor at wet well shall not be painted.
2. All piping shall be shop finish painted.

**2.3 COLOR CODING.**

A. Piping and electrical conduit shall be color coded with colors as selected by the Engineer. Electrical conduits shall be painted the color of the wall/ceiling against which it is run. Conduits are not required to be painted if they are not running against a wall or ceiling.

**2.4 NON-SLIP FLOOR COATING.**

A. Concrete floors above the wet pit shall have an abrasive coating of Series 69 Hi-Build Epoxoline II as manufactured by Tnemec Co., Inc., or equal. Bare concrete shall be primed at a dry film thickness of 2.0-3.0 mils. The first coat shall have a dry film thickness of 2.0-3.0 mils which includes silica sand to provide a non-skid surface. The second coat shall have a dry film thickness of 2.0-3.0 mils. The epoxy coating shall be applied in accordance with the manufacturer's recommendations.

**PART 3 – EXECUTION:**

**3.1 PREPARATION.**

A. Inspect surfaces with regard to their suitability to receive a finish after preparatory work. The application of finish shall be an indication of the Contractor's acceptance of the surface.

B. Clean surfaces to be painted of loose dirt and dust before painting is started. Adjacent surfaces shall also be clean before starting painting. Do preparatory work necessary to produce a surface suitable to receive the specified finish.

C. Wash uncoated metal surfaces with mineral spirits to remove dirt and grease before applying paint materials. Blast profile shall not exceed 30% of total film thickness of coating. Preparation shall conform to primer manufacturer's requirements. Prime surfaces as soon as practical after preparation. Do not leave prepared, uncoated surfaces overnight. Touch up shop coats damaged by welding or abrasion.

D. Prior to painting, all surfaces shall be prepared and cleaned as specified and required. Surfaces shall be dry before any paint is applied. Special surface preparation work shall be as directed by the manufacturer of the paint specified to be applied to the surface. Paint shall not be applied before the prepared surfaces are approved.

E. Prior to painting steel, all welds, beads, blisters or protuberances, other than identification markings, shall be ground smooth. Pits and dents shall be filled, and other imperfections shall be removed. All rust, mill scale, oil, grease and dirt shall be removed by sandblasting in the shop in accordance with Society of Protective Coatings Specification No. SP-10, Near White (SSPC-SP-10). Cleaned metal shall be primed the same day immediately after sandblasting to prevent rusting.

F. Prior to painting other metals, all welds, beads, blisters or protuberances, other than identification markings, shall be ground smooth and other imperfections shall be removed. All nonferrous metals, galvanized steel and stainless steel whether shop primed or field primed, shall be solvent-cleaned in accordance with SSPC-SP-1 prior to the application of the primer. Nonferrous metal shall be treated with Oakite 747 LTS, as manufactured by Chemetel or equal before prime coat is applied.

G. Pipe covering and duct covering shall have all adhering debris removed and indentations or unsightly spots smoothed out to an even surface and shall be brushed clean.

H. Concrete surfaces and concrete masonry shall be brushed and washed. All loose dirt, free lime, form oil, curing compounds and other foreign matter shall be removed by approved methods. Concrete surfaces requiring repair shall be patched and surfaces to receive

paint shall be spackled and repaired. Concrete surfaces to be painted shall be acid-etched as recommended by the manufacturer of the coating to be applied to produce a slightly granular surface required for adherence of the paint to the concrete unless otherwise indicated. Concrete and concrete masonry shall be thoroughly dry prior to painting.

## 3.2 PROTECTION OF NON-FINISH ITEMS.

A. Furnish and lay drop cloths or other means of protection for finished surfaces during the work.

B. Before painting, remove hardware, accessories, plates, lighting fixtures and similar items or provide ample protection of such items. Upon completion of work in each area, replace above items. Use only skilled mechanics for removing and replacing items.

C. If finished surfaces are damaged, entirely remove the stains or replace the damaged material, making good any damage to other work in connection therewith, without additional cost to the Owner.

## 3.3 APPLICATION.

A. The following items shall not be painted, unless otherwise specified: ducts, covering over ducts, registers, grilles, dampers and linkage, name and identification plates and tags, floor gratings, brass valves, stainless steel, wood, cast-iron piping installed underground, fiber reinforced plastics or resins, glazed cmu.

1. The following items shall be furnished with the manufacturer's standard prime and finish coats applied in the shop: pumps, motors, air compressors, wall fans, control and SCADA panels, panelboards, transformers, unit heaters, aluminum fascia, motor control centers, hoisting equipment.

2. The following items shall be shop primed and field painted: structural steel and wrought metals, pipelines, hangers and supports, valves, valve operators and stands, guard housings, steel lintels, hollow metal doors and frames.

3. All items not shop primed or shop finished shall be field primed and finished where exposed to view. The work shall generally include, but not be limited to, the following: interior concrete block, interior concrete walls, columns, beams and ceilings, covering over insulation on piping, electrical conduit, small piping and copper tubing, exterior PVC piping.

B. The work shall include all touch-up and remedial painting as required until the completion and acceptance of the final work.

C. Spray painting shall not be allowed.

## 3.4 INSTALLATION.

A. Furnish equipment for the proper execution of the work. Erect and place same in such a way as not to interfere with work of other trades. Upon completion, dismantle and remove same from the job site.

B. Employ skilled mechanics to ensure good workmanship. Thoroughly mix materials immediately before application of paint. Surfaces shall be clean, dust free, dry and adequately illuminated. Each coat shall be thoroughly dry before applying succeeding coat.

C. Finished work shall be uniform and of approved color, smooth and free from runs, sags, and defective application. Edges of paint adjoining other materials or colors shall be sharp and clean, without overlapping. Before applying succeeding coats, primers and undercoats shall be completely integral and performing the function for which they are specified. Prepare and touch up scratches, abrasions, or other disfigurement and remove any foreign matter between successive coats.

D. Blast cleaned metal surfaces shall be coated immediately after cleaning, before any rusting or other deterioration or contamination of the surface occurs. Blast cleaned surfaces shall be coated not later than eight hours after cleaning under ideal conditions or sooner if conditions are not ideal.

E. Avoid degradation and contamination of blasted surfaces and avoid intercoat contamination. Clean contaminated surfaces before applying next coat. Ensure method of cleaning contaminated surface follows manufacturer's recommendations.

F. Primers and undercoats of paint and enamel shall be tinted or shaded different colors than the finish coats. Each coat of material shall be inspected and approved by the Engineer before application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the work in question shall be recoated. Inform the Engineer when each coat is ready for inspection and approval.

G. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.

H. Painting shall not be done when the temperature is below 10 degrees C (50 degrees F) and when satisfactory results cannot be obtained due to high humidity or excessive temperatures. Paints or other finishes shall not be applied to wet or damp surfaces.

I. All painting shall be done in accordance with the paint manufacturer's recommendations.

J. All wall surfaces which will be concealed by equipment shall be painted before equipment installation.

## 3.5 CLEANING.

A. Upon completion of painting work, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

B. Rubbish, debris, empty paint cans and discarded materials shall be placed in metal containers and removed from the site.

## 3.6 SCHEDULE.

A. Material Painting Schedule

| Class of Work | Primer Shop Coat | Field or Shop Finish Coats | | |
|---|---|---|---|---|
| | | 1st | 2nd | 3rd |
| Nonferrous Metal and Galvanized Steel: | | | | |
| Interior | | A | A | A |
| Exterior | I | A | A | C |
| Steel and Iron: | | | | |
| Interior | B | B* | A | A |
| Exterior | B | B* | A | C |
| Submerged or Constantly Wetted | B | B* | D | D |
| Asphaltic Coated Steel | | E* | A | A |
| Concealed in Masonry | B | B* | | |
| Exposed to Potable Water | B | B* | B | F |
| Wrapped in Insulation | B | B* | | |
| Exterior, Exposed to Process Wetting and Drying | B | B* | D | D |
| Concrete: | | | | |
| Interior | | A | A | A |
| Exterior | | H | H | H |
| Interior Pipe: | | | | |
| Interior Exposed or Immersed Ductile Iron | | J | D | D |
| | | | | |
| PVC | | A | A | |

*Touch-up bare metal with primer.

B. Paint Schedule

1. Alphabetical designations in the following list are given solely for the purpose of indicating the type and quality of materials desired. Equivalent material from other approved manufacturers may be substituted.

| Symbol | Product Name and Number | Volume Solids % | Dry Film Thickness | |
|---|---|---|---|---|
| | | | Micrometers | Mils Per Coat |
| A | Tnemec Series 69 Hi-Build Epoxoline II | 69 | 51-76 um | (2.0-3.0 mils) |

| | | | | |
|---|---|---|---|---|
| B | Tnemec Series 140-1225 Beige Pota-Pox Plus | 69 | 102-152 | (4.0-6.0) |
| C | Tnemec Series 73 Endura-Shield | 58 | 51-76 | (2.0-3.0) |
| D | Tnemec Series 69 Hi-Build Epoxoline II | 69 | 76-127 | (3.0-5.0) |
| E | Tnemec Series 90-97 Tneme-Zinc | 63 | 64-89 | (2.5-3.5) |
| F | Tnemec Series 140-WH02 (15BL) Pota-Pox Plus | 69 | 102-152 | (4.0-6.0) |
| G | Tnemec Series 69 Hi-Build Epoxoline II | 69 | 178-254 | (7.0-10.0) |
| H | Tnemec Series 180 Acrylic Emulsion | 44 | 102-152 | (4.0-6.0) |
| I | Tnemec Series 69 Inorganic Zinc Rich | 69 | 51-76 | (2.0-3.0) |
| J | Tnemec Series 1 Omnithane | 61 | 64-89 | (2.5-3.5) |

C. Notes

1. Where aluminum surfaces come in contact with incompatible metals, lime, mortar, concrete or other masonry materials, these areas shall be given one field coat of Tnemec Series 69 Hi-Build Epoxoline II. (G)

2. Stainless steel, where indicated shall be protected by two coats of clear acrylic lacquer conforming to the requirements of Military Specification MIL-L-81352A. Surface preparation shall consist of removing all oil and foreign matter by wiping clean with cloth and lacquer thinner.

3. Applicable to insulated and uninsulated pipes: Steel pipe not available with a shop coat shall be prime coated in the field immediately after installation.

4. Piping shall be painted up to and including the flanges attached to mechanical equipment. Electrical conduit shall be painted up to and including the flexible conduit connected to equipment.

5. All steel pipes, ductile iron fitting and flanges located at the wet well, intermediate floor and discharge floor shall be shop finish painted before shipment. Provide field touch-up paint as required.

D. General Color Scheme

1. General color scheme shall be as follows:

   a. Exterior Concrete Walls - light beige.
   b. Interior Concrete Walls – matching light “beige” color:(Provide a selection of “Beige” colors that are an array of close matches to the selected color for glazed CMU walls. Final color to be selected by Engineer.)
   a. Interior Concrete Ceiling – white: (Provide a selection of “White” colors for review. Final color to be selected by Engineer.)
   b. Interior Grade Floor - gray.
   c. Lower Level Concrete Wall – Tannery.
   d. Interior Steel Frame and Metal Trim – light gray.
   e. Exterior Metal Trim (except aluminum and stainless steel) – light gray.
   f. Exterior piping and appurtenances – Turbine Blue – verify with Engineer.
   g. Interior piping – Turbine blue – verify with Engineer.
   h. Electrical Conduits – light gray.
   i. Fire protection equipment – standard red.
   j. Hoist Beams/Trolley – Safety red.
   k. Bollards – Safety yellow.

2. Note: Contractor to submit manufacturer’s color chart for Engineer’s selection.

**END OF SECTION 09 91 00**

**DIVISION 10 - SPECIALITIES**

**SECTION 10 00 00 - SPECIALTIES**

**PART 1 – GENERAL:**

**1.1 DESCRIPTION.**

A. This item of work includes the furnishing and installation of bulletin board, fire extinguishers, first aid kit, shop desk, nameplate, trash bins and related items to complete the work shown and specified.

B. Refer to Division 1 for additional requirements.

**1.2 RELATED SECTIONS.**

A. Section 05 05 23 - Bolts, Anchor Bolts, Expansion Anchors, and Concrete Inserts.

B. Section 09 91 00 – Painting.

**1.3 SUBMITTALS.**

A. Submit shop drawings and product data under provisions of Section 1A.

**1.4 DELIVERY, STORAGE AND HANDLING.**

A. Delivery, storage and handling shall be in accordance with the provisions of Section 01 01 00 – SUMMARY OF WORK.

**1.5 GUARANTEE.**

A. Provide guarantee under provisions of Section 1A.

**1.6 BASIS OF PAYMENT.**

A. Specialties shall be paid for as part of the Contract lump sum price for PUMP STATION GENERAL WORK which shall be payment in full for work described herein.

**PART 2 – PRODUCTS:**

**2.1 BULLETIN BOARD.**

A. Furnish and install one (1) two panel bulletin board. Bulletin board panels shall be 1/4" cork mounted on hardboard. Overall dimensions shall be approximately 40" high, 36" long, 3" deep.

## 2.2 STATION IDENTIFICATION PLATE.

A. Furnish and secure in position and location, one cast aluminum tablet for each such required tablet. The tablet shall be made by a firm specializing in aluminum tablet work and shall be of best grade of aluminum available. Lettering shall be arranged as directed and of a style to be selected. All lettering and designs to be of embossed type, milled and polished. Background shall be pebble finish, left rough. A full-size rubbing shall be submitted for approval before casting.

B. Lettering shall read as shown on drawing.

## 2.3 STAFF GAUGES.

A. Two staff gauges (one in the wet pit and one in the discharge chamber), calibrated in feet and tenths of a foot, shall be provided to show the depth of the water. Staff gauge range shall be from 0’ to 20’ for wet well and 0’ to 5.5’ for discharge chamber.

B. Each gauge shall be porcelain enameled iron rod. The rods shall be professional type, 2-1/2" wide minimum, with large bold markings of a height for the full height of the wet well.

C. Each staff gauge shall be attached and supported using corrosion resistant hardware at locations to avoid conflict with level controls, etc.

## 2.4 SHOP DESK.

A. A metal shop desk shall be provided. The desk shall have a 43 inch high work surface and shall be approximately 53 inches high by 34.5 inches wide by 30 inches deep. The unit shall have a rear top shelf riser, a 3.5 inch high drawer on nylon rollers and a large storage compartment with locking door and an adjustable shelf. The unit shall have 14 ga. corner posts and a minimum 20 ga. top and shall have a gray enamel painted finish.

## 2.5 FIRST AID KIT.

A. Furnish and install two first aid kits with brackets for wall mounting as directed in the pump room and electrical room. The kit shall be Model No. 640135 as manufactured by Johnson and Johnson or equal.

## 2.6 FIRE EXTINGUISHERS.

A. Furnish and install ten (10) fire extinguishers as directed. The extinguishers shall be multipurpose Dry Chemical Type with a U.L. rating of 20A: 120B: C, 20 pound capacity in enameled steel containers. The extinguishers shall be installed with wall brackets of size required for type and capacity of extinguisher indicated.

## 2.7 CLOCK.

A. Clock shall be synchronous motor type, 12" face, 120 V. 60 Hz.

**2.8 TRASH CAN.**

A. Trash can shall be made of polyethylene and the capacity shall be approximately 40-50 gallon industrial type with lid, wheels/casters. To be located on the ground level of the wet well area.

**PART 3 - EXECUTION:**

**3.1 INSTALLATION.**

A. Install the specified specialties in accordance with manufacturer's recommendations and instructions to permit intended performance.

B. The manufacturer or supplier of the specified specialties shall furnish a qualified field engineer for whatever period of time may be necessary to assist and direct the contractor in the proper installation of the equipment furnished, to observe and check initial performance, and whose duty shall include the instruction of the plant operating personnel in the proper operating and maintenance procedures.

**3.2 PAINTING.**

A. The specified specialties shall be painted in accordance with applicable AWWA standard specified and with Section 09 91 00 of these specifications.

**3.3 TESTING.**

A. The specialties shall be tested in place by the Contractor, and any defects in specialties or connections shall be corrected to the satisfaction of the Engineer.

**END OF SECTION 10 00 00**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**

**SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Painting and finishing.
6. Supports and anchorages.

B. General: Work shall be performed in accordance with these specifications and good practice. No modifications to these specifications will be accepted without the expressed written approval of the OWNER. It is the CONTRACTOR'S responsibility to document OWNER'S approval of any such modifications prior to the execution of work. Requirements of these Specifications modified by any addenda, change orders, written approvals and written instructions issued by the OWNER, if any, shall be as specifically identified by Section and Paragraph in those addenda, change orders, written approvals and written instructions. Approvals of submittals are subject to additional limitations described elsewhere in these Specifications. System concept drawing sheets are for information only to show potential system arrangement. Field verify information contained on these drawings and is responsible for design and installation of the system in accordance with the specifications. The bid drawings do not show all information necessary for installation of the system, but are intended to be used as a guide for the purpose of designing the systems and preparing a bid.

**1.2 DEFINITIONS**

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.
4. HDPE: High density Polyethylene pipe.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

## 1.3 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

## 1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31, "Building Services Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## 1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Section 23 33 00 "Air Duct Accessories."

## PART 2 - PRODUCTS

## 2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast- bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

## 2.3 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturer: Subject to compliance with requirements, manufacturers provide products by one of the following:

a. Eslon Thermoplastics.
b. Spears Manufacturing Co.
c. Lasco Fittings, Inc.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers: Subject to compliance with requirements, manufacturers provide products by one of the following:

a. Thompson Plastics, Inc.
b. NIBCO, Inc.
c. Eslon Thermoplastic

C. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union.
Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers: Subject to compliance with requirements, manufacturers provide products by one of the following:

a. NIBCO INC.
b. Eslon Thermoplastic
c Spears Manufacturing Co.

## 2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.
C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 Deg F.

1. Manufacturers: Subject to compliance with requirements, manufacturers

provide products by one of the following:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers: Subject to compliance with requirements, manufacturers provide products by one of the following:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly.
Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers: Subject to compliance with requirements, manufacturers provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 Deg F.

1. Manufacturers: Subject to compliance with requirements, manufacturers provide products by one of the following:

a. Calpico, Inc.
b. Lochinvar Corp.
c. Advance Products & System Inc.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 Deg F.

1. Manufacturers: Subject to compliance with requirements, manufacturers

provide products by one of the following:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.

## 2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

# PART 3 - EXECUTION

## 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Section 07 62 00 "Sheet Metal Flashing and Trim" for flashing.

        1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Section 07 92 00 "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements

to expand and make watertight seal.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

## 3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

## 3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

## 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

## 3.5 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Section 09 90 00 "Painting", and Section 230503 “Basic Mechanical requirements for HVAC Systems”.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

## 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 05 50 00 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

**END OF SECTION**

# DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING

## SECTION 23 05 03 - BASIC MECHANICAL REQUIREMENTS FOR HVAC SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A This section includes the following

1. General provisions for mechanical work
2. Supplements all other Sections within Mechanical Division 23.

### 1.2 RELATED WORK

A. Division 03 - Concrete

B. Division 09 - Finishes

C. Division 23 – Heating ventilating and air conditioning

D. Division 26 – Electrical

E. Division 40 – SCADA System

### 1.3 CODES

A. The City of Lake Forest Building Code applies to all construction within the City of Lake Forest limits.

### 1.4 STANDARDS

A. Comply with requirements and recommendations of the standards or publications listed below, except where more stringent requirements or recommendations are described by other industry-accepted standards or publications.

1. Air Conditioning and Refrigeration Institute
2. Air Moving and Conditioning Association
3. American Gas Association
4. American National Standards Institute
5. American Petroleum Institute
6. American Society of Heating, Refrigeration and Air Conditioning Engineers
7. American Society of Mechanical Engineers
8. American Society of Plumbing Engineers
9. American Society of Testing and Materials
10. American Water Works Association
11. American Welding Society
12. Associated Air Balancing Bureau
13. Association of Safety Engineers

14. Cast iron Soil Pipe Institute
15. Electronic Industries Association
16. Environmental Protection Agency
17. Factory Mutual Insurance Association
18. Hydraulic Institute Standards
19. Industrial Risk Insurers
20. Institute of Electrical and Electronics Engineers
21. National Electric Code
22. National Electrical Manufacturers Association
23. National Environmental Balancing Bureau
24. National Fire Protection Association
25. National Sanitary Foundation
26. Occupational Safety & Health Administration
27. Sheet Metal and Air Conditioning Contractors National Association
28. Underwriters' Laboratories

## 1.5 SUBMITTALS

A. Shop Drawing, Operation and Maintenance Manual, and Project Record Document Submittals

1. Refer to Division 1 General Requirements for submittal requirements.

2. Test report submittal requirements

   a. The CONTRACTOR shall submit test reports to the OWNER with data obtained when all final balancing and adjustments have been made to air systems.
   b. Testing, adjusting, and balancing shall be conducted in accordance with the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB) Standards, or equivalent procedures.
   c. Testing includes:

      1) Checking all systems and components to assure that they meet Contract Document requirements for capacity, system operation, and control function.
      2) Checking for proper flow directions.
      3) Checking of all voltages for each motor.
      4) Checking that all motors rotate in the correct direction and at the correct speed.
      5) Checking all motors for possible overload (excess amperage draw) on initial start-up.
      6) Checking systems for leaks.

## 1.6 QUALITY ASSURANCE

A. Off-the-shelf conditions should not be assumed to comply with the specified requirements. Do not purchase any mechanical materials or equipment until the review of submittals of these materials and equipment by the OWNER.

B. Unless indicated otherwise, only provide new mechanical products. All mechanical products shall be free of defects and harmful deterioration.

C. Provide each product complete with trim, accessories, finishes, guards, safety devices, and similar components recognized as integral to the product or as required by governing regulations.

D. To the greatest extent possible, unless otherwise indicated, complete the fabrication, assembly, finishing, and testing of products prior to delivery to the site.

1. CONTRACTOR Qualifications: Installation of the equipment must be performed only by a qualified installer. The term qualified means experienced in performing the work required by this Section. The qualified installer will be responsible for demonstrating to the OWNER'S satisfaction that he/she has sufficient experience in its role. The installer must submit evidence of such qualifications upon request by the OWNER.

E. Manufacturer Qualifications: Fabrication of the equipment must be performed only by a qualified fabricator. The term qualified means experienced in performing the work required by this Section. The qualified fabricator will be responsible for demonstrating to the OWNER'S satisfaction that he/she has sufficient experience in its role. The qualified fabricator must submit evidence of such qualifications upon request by the OWNER.

## 1.7 DELIVERY, STORAGE AND HANDLING

A. Products shall be adequately packaged or protected to prevent deterioration during shipment and storage. Except where protected specifically for exterior storage, store in a dry and well ventilated indoor space. So that storage requirements at the site are minimized, coordinate the deliveries of products with the scheduling of the work.

B. Motors exposed to any amount of moisture shall be completely dried out before connection and start-up. CONTRACTOR shall be responsible until OWNER acceptance.

C. Fans not in operation to have shafts rotated by hand each week.

# PART 2 - PRODUCTS

## 2.1 EQUIPMENT AND MATERIALS

A. Base Bid shall cover products of specified manufacturers only.

## 2.2 MANUFACTURER'S NAMEPLATES

A. Each major component of equipment shall have the manufacturer's name and address as well as model number, capacity rating, serial number, labels of tested compliances, and other pertinent data on a nameplate securely affixed in a conspicuous place. The nameplates of the distributing agent will not be acceptable. Any ASME Code Rating shall be in an easily visible location.

## 2.3 OPERATIONAL SIGNS

A. Where needed for proper identification, operation, maintenance, or safety, provide appropriate signs of engraved plastic-laminate or tags of plasticized card stock.

# PART 3 - EXECUTION

## 3.1 VISITING THE SITE

A. The CONTRACTOR shall fully inspect all physical conditions, site characteristics, means of egress from and access to the structure and site, and any peculiarities or unusual features of the structure and site that may affect the cost of the work.

## 3.2 PERMITS AND FEES

A. The CONTRACTOR shall be responsible for obtaining and paying for all permits, licenses, and certificates necessary for the completion of work.

## 3.3 PRODUCT INSTALLATION - GENERAL

A. No piping or ductwork shall be installed in electrical equipment rooms. Fire protection piping shall not be installed in electrical rooms or electrical areas unless permitted by the City of Lake Forest building officials, or other relevant authority.

B. The mechanical Contract Drawings depict the general layout of mechanical work. Equipment, accessories, specialties, and piping systems shown are diagrammatic and do not necessarily indicate every required valve, fitting, trap, elbow, etc. Provide all items required for complete operating mechanical systems.

C. All equipment with moving parts, such as gears, pulleys, belts, links, etc., shall be covered or guarded in a manner complying with provisions of all pertinent federal, state, or local regulations. All guards shall be constructed of metal not thinner than 16 gauge.

D. Before any rotating equipment is put in operation, it shall be properly lubricated, with lubricants only as recommended by the manufacturer. This equipment shall include any fans and pumps that are part of this Project.

E. Removals and relocations shall be performed in a neat and workmanlike manner. Items that are damaged shall be repaired or replaced with new items as required by the OWNER.

F. Patching shall be performed in a neat and workmanlike manner. Finished surfaces of patched area shall be flush with adjacent existing surfaces and shall match the existing surfaces in texture and finish.

G. Except with the permission of the OWNER, do not cut structural framing, walls, floors, decks, and other members intended to withstand stress.

H. Arrange mechanical work with a minimum of 7'-0" overhead clearance where possible.

I. In no case shall any pipe, conduit, duct, or item of equipment be installed where it is supported on, or suspended from, another pipe, conduit, duct, or equipment.

## 3.4 COORDINATION WITH OTHER WORK

A. Before making any installations, make necessary arrangements to avoid interferences with other systems.

B. For locations where several elements of project work must fit into an available space, prepare Coordination Drawings showing accurate physical dimensions. Submit these drawings to the OWNER for review prior to purchase, fabrication, and installation of work.

C. If any work is installed so that project work that will be installed later will not have required clearances or will interfere with finished design, the CONTRACTOR shall make changes, as directed by the OWNER, to permit the proper installation of all work under the Contract.

## 3.5 ACCESS PANELS

A. If control valves, shut-off valves, dampers, pull boxes, or other specialties which require service or adjustment, are inaccessible, the CONTRACTOR shall furnish and install access panels as required.

B. Provide access panels at each fire, volume, or isolation damper installed in the ductwork. Where ductwork exceeds 72" in width, install two (2) panels or doors equally spaced across the width of the duct.

## 3.6 WIRING DIAGRAMS

A. CONTRACTOR shall provide each major piece of electrically connected, controlled, or operated equipment with specific wiring diagrams and instructions. Diagrams and instructions shall not be of a general or typical nature, but applicable to the specific job.

B. Where motor starters come as an integral part of equipment, starters shall meet the requirements of the Electrical Division of these specifications, including the following:

1. Overload protection on all three phases.
2. All heating, ventilating and temperature control starters shall have “Hand-Auto-Off” switch.
3. The brand of starter shall be limited to one of those specified in the Electrical Division.
4. All control wiring shall be installed in conduit.

## 3.7 PAINTING

A. Before delivery to the site, all shop-fabricated and factory-built equipment not galvanized or protected by painting, shall be cleaned and given one shop coat of zinc-chromate primer. Any portions of the shop coat damaged in delivery or during construction shall be recoated.

B. After delivery, paint mechanical work in colors to match adjoining non-mechanical work where not painted under other Sections of this specification. Apply zinc- chromate prior and one or more finish coats totaling 2.5 mils dry film thickness, over surfaces which have been properly prepared. Omit prime coat where surface has been factory prime coated, and coating is substantially without damage. Apply paint under proper environmental conditions. Do not paint over fully factory finished surfaces unless original color is unacceptable. Do not paint over nameplates, non-ferrous hardware, sliding/rotating shaft contact surface, and similar surfaces intended for exposure without painting. Paint the following work where accessible for painting:

1. Ferrous metal, excluding cast iron which is concealed from view.
2. Zinc-coated metal, excluding concealed work.
3. Insulation on mechanical work, excluding concealed work and foil-faced insulation.
4. Concrete work which is placed similar to nonmechanical concrete work which is indicated to be painted.
5. Ductwork interiors which are visible through grilles or louvers, interior and exterior; paint black.

C. Hangers installed outdoors shall have two coats of rust inhibitor paint, to be applied after installation and adjustment.

## 3.8 TOOLS

A. On completion of the work, the CONTRACTOR shall deliver to the OWNER, any special tools that may be required for the proper servicing of any equipment that the CONTRACTOR has been furnished on the Project.

**END OF SECTION 23 05 03**

# DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING

## SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This section includes the following:

1. Single-phase electric motors
2. Three-phase electric motors

### 1.2 RELATED WORK

A. Division 23 – Instrumentation and control for HVAC

B. Division 26 - Electrical

### 1.3 REFERENCES

A. As a minimum, meet the requirements of the following codes and standards.

1. The City of Lake Forest Building Code applies to all construction within the City of Lake Forest limits
2. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings
3. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings
4. IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators
5. NEMA MG 1 - Motors and Generators
6. NFPA 70 - National Electrical Code

### 1.4 SUBMITTALS

A. Refer to the Basic Mechanical Requirements for HVAC System Section, 230503.

B. Submit Shop Drawings, product data, and operation and maintenance manuals.

1. Include wiring diagrams with electrical characteristics and connection requirements.
2. Provide speed-torque curves and time-current curves.
3. Show the locations and sizes of terminal boxes, conduit entrances, lug connections, and total weight of motors.
4. Indicate test results verifying nominal efficiency and power factor.
5. Indicate settings, mechanical connections, and lubrication.

### 1.5 QUALITY ASSURANCE

A. Refer to the Basic Mechanical Requirements for HVAC System Section, 230503.

B. All motors shall be UL or CSA listed for the applications and locations intended.

C. Motor sizes indicated in these specifications are based on the published data of equipment manufacturers and shall not relieve the CONTRACTOR of the responsibility for furnishing motors of adequate size and efficiency for the proposed equipment. All increases in electrical system costs that are the result of furnishing acceptable motors shall be borne by the CONTRACTOR.

D. Nameplates shall indicate motor horsepower, voltage, phase, cycles, rpm, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

E. CONTRACTOR Qualifications: Installation of electric motor equipment and accessories must be performed only by a qualified installer. The term qualified means experienced in performing the work required by this Section. The qualified installer will be responsible for demonstrating to the OWNER'S satisfaction that he/she has sufficient experience in its role. The installer must submit evidence of such qualifications upon request by the OWNER.

F. Manufacturer Qualifications: Fabrication of electric motor equipment and accessories must be performed only by a qualified fabricator. The term qualified means experienced in performing the work required by this Section. The qualified fabricator will be responsible for demonstrating to the OWNER'S satisfaction that he/she has sufficient experience in its role. The qualified fabricator must submit evidence of such qualifications upon request by the OWNER.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. (NOT USED)

## 1.7 EXTRA MATERIALS AND SPARE PARTS

A. (NOT USED)

# PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers provide products by one of the following:

1. Westinghouse
2. U. S. Motor
3. Siemens-Chambers
4. Louis Allis
5. Reliance

B. The design of this project, including all plans, drawings, and construction details, is based on the stated manufacturer's model numbers. If the CONTRACTOR intends to provide items or equipment from any of the other acceptable manufacturers listed in the Contract Documents, then the CONTRACTOR shall be responsible for the cost of any and all work, including, but not limited to additional design, engineering, labor, material,

equipment and incidental costs, necessary to accommodate such items or equipment for this project.

C. Any and all work that may be required to accommodate any items or equipment of the other acceptable manufacturers listed in the Contract Documents is, without limitation, subject to the review of the OWNER.

## 2.2 PRODUCT DESCRIPTION

A. Motors less than 250 watts for intermittent service shall meet equipment manufacturer's requirements and are not required to conform to this Section of the specifications.

B. A.C. motors shall be operated at the following voltages, unless otherwise shown on the Contract Drawings:

1. Motors under 1/2 horsepower shall be capacitor induction type, 115 volts AC, single phase, 60 Hertz.
2. Motors 1/2 horsepower and larger shall be squirrel cage type, 460 volts AC, 3 phase, 60 Hertz.

C. Motors shall be capable of delivering rated horsepower output successfully and continuously under conditions of voltage variations of 10 percent above and below rated voltage.

D. Motors shall have a service factor of 1.15.

E. Motors shall have output torque and speed characteristics to operate the driven equipment under design load conditions, without exceeding the motor nameplate ratings. Motors may be overloaded up to 10 percent for extreme loading conditions, unless otherwise specified.

F. Definite purpose motors shall be used on specialized equipment requiring them. Ratings shall be based on a permissible temperature rise above an ambient of 40 degrees C, given in the Standards for the class of insulation used, on totally enclosed motors. This temperature rise shall be for continuous operation, unless otherwise specified.

G. Motor insulation, unless otherwise indicated, shall be of the Mill and Chemical type non-hygroscopic, NEMA Class F insulation with a maximum temperature rise of 80 degrees C above a maximum 40 degrees C ambient at not over 3300 feet altitude (as measure by resistance). Stator windings shall be of copper.

H. The size of the motors shall be established by the equipment manufacturer of the driven equipment, and shall be adequate to assure the specified output and/or proper operation of the driven equipment without loading the motors beyond name plate full load ratings. In addition to having sufficient horsepower output rating at rated speed, all integral horsepower motors shall have performance characteristics which will allow, without injurious overheating of the motors, accelerating the WR2 of the load from standstill to rated speed under conditions of the follows:

1. Two starts in succession (coasting to rest between starts) with the motors initially

at ambient temperature.

2. One start with the motors initially at temperature not exceeding their rated load operating temperature.

I. The CONTRACTOR shall note that thermal characteristics of motors regarding the capability for accelerating the WR2 of the load may vary greatly among various motor manufacturers, even if the horsepower rating is the same. It is the CONTRACTOR'S responsibility to provide motors with adequate rated-speed operating characteristics.

J. All motors, except where the driven equipment presents unusual requirements, shall have torque and locked rotor characteristics as described in NEMA Standards for Design B.

K. Generally, motors shall be of the totally-enclosed type. Vertical motors shall have solid shafts, with high ring bases having ample space for coupling adjustments. Motors larger than 2 horsepower shall be fan-cooled. All totally-enclosed motors shall be tapped at a low point and fitted with a 1/4 inch universal drain-breather fitting, similar to manufactured by Crouse-Hinds, Series ECD, or Appleton Electric.

L. In general, motors shall be of the totally-enclosed fan-cooled type in dry non-hazardous location; and weather protected Type II with watertight connection boxes where exposed to dampness or exterior weather conditions. Motors in hazardous areas shall have the Class, Division, and Group as required by applicable national and local electric codes.

M. Explosion-proof motors shall be UL-listed and labeled for hazard classification, with over-temperature protection.

N. All motors shall be of cast iron construction, including the motor frame, end shields, fan cover, and conduit box.

O. Direct-connected motors shall be provided with acceptable couplings. Motors shall be doweled into the base plates at least at two points.

P. Motors for belt-driven equipment shall be provided with slide rails, adjustment screws, pipe sleeves, anchor bolts, and cast iron bed plates. Slide rails shall be slotted for adjustment with the take-up screws.

Q. All gear motor and speed reducers shall be designed for correct mounting position and be rated in accordance with the Standards of the American Gear Manufacturers Association, Class II service.

R. Bearings shall be of a type suitable for the application. Generally, ball bearings shall be provided for motors 250 horsepower and smaller, and sleeve bearings provided for larger motors. Pre-lubricated, seal ball bearing shall be provided for motors under 20 horse-power; larger size motors shall have ball bearings with pressure grease fittings and drain ports. Thrust bearings, rated for the application, shall be provided where necessary.

S. In general, all motor bearings shall be of the antifriction type. All antifriction bearings shall have a minimum rating life of 100,000 hours, based on a reliability of 90

percent in accordance with ANSI B3.15.

T. For larger motors, motor bearings shall be oil- or grease-lubricated, with accessible provisions for inspecting and servicing; smaller motors may have sealed-for-life type bearings.

U. Windings and number of leads brought to the motor terminal fittings shall be suitable for the starting arrangement specified or indicated in the Contract Drawings. Oversized terminal fittings or boxes shall be provided where necessary to accommodate the number and size raceways to be connected. All leads brought out shall be clearly and permanently identified and provided with suitable terminals or lugs.

V. Wiring Terminations

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to the requirements of NFPA 70, threaded for conduit.
2. For fractional horsepower motors, where connections are made directly, provide conduit connection in end frame.

W. The dynamic balance, over speed withstand capability, and sound power levels of motors shall conform with NEMA Standards.

## 2.3 BELT GUARDS

A. Every belt-drive shall be provided with a N.S.C. and O.S.H.A. approved belt guard, enclosing all belts and sheaves.

B. Guards shall be constructed of No. 12 U.S.S. gauge steel, 3/4" diamond mesh wire screens, or equivalent, welded to 1" structural steel, with 1/8" thick angle frames. Tops and bottoms to be of substantial sheet metal, not less than No. 18 U.S.S. gauge.

C. Guards shall be secured to the driven machines, foundations, or floors by heavy structural angle supports and anchor bolts. Braces or supports secured to motors will not be permitted. Braces or supports must not “bridge” the sound and vibration isolators.

D. Guards shall be designed with adequate provisions for movement of motor to adjust belt tension. Means shall be provided to permit use of speed counters and other maintenance and testing operations with belt guards in place.

E. Lubrication fittings shall be extended to points that will permit lubrication without removing guards.

F. Guards shall be removable for maintenance.

## 2.4 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque

B. Starting Current: Up to seven times full load current

C. Breakdown Torque: Approximately 200 percent of full load torque

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, pre-lubricated sleeve or ball bearings

E. Enclosed Motors: Class A insulation, pre-lubricated ball bearings

## 2.5 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque

B. Starting Current: Up to six times full load current

C. Multiple Speed: Through tapped windings

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A insulation, pre-lubricated ball bearings, automatic reset overload protector

## 2.6 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque

B. Starting Current: Less than five times full load current

C. Pull-up Torque: Up to 350 percent of full load torque

D. Breakdown Torque: Approximately 250 percent of full load torque

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds

F. Enclosed Motors: Class A insulation, pre-lubricated ball bearings

## 2.7 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque

B. Starting Current: Six times full load current

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics

D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors

E. Insulation System: NEMA Class B or better

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine freedom from electrical or mechanical defects in compliance with performance data.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts

H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter

I. Sound Power Levels: To NEMA MG 1

J. Part Winding Start Where Indicated, or Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

K. Weatherproof Epoxy Treated Motors: Epoxy treated motors with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease

L. Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112

M. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112

## 2.8 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

| HP | 3600 RPM | 1800 RPM | 1200 RPM | 900 RPM |
|---|---|---|---|---|
| 1/6-1/3 | 1.35 | 1.35 | 1.35 | 1.35 |
| ½ | 1.25 | 1.25 | 1.25 | 1.15 |
| 3/4 | 1.25 | 1.25 | 1.15 | 1.15 |
| 1 | 1.25 | 1.15 | 1.15 | 1.15 |
| 1.5-150 | 1.15 | 1.15 | 1.15 | 1.15 |

## 2.9 PERFORMANCE SCHEDULE, THREE PHASE - ENERGY EFFICIENT, OPEN DRIP-PROOF

| HP | RPM (Syn) | NEMA Frame | Minimum Percent Efficiency | Minimum Percent Power Factor |
|---|---|---|---|---|
| 1 | 1200 | 145T | 81 | 72 |
| 1-1/2 | 1200 | 182T | 83 | 73 |

| | | | | |
|---|---|---|---|---|
| 2 | 1200 | 184T | 85 | 75 |
| 3 | 1200 | 213T | 86 | 60 |
| 5 | 1200 | 215T | 87 | 65 |
| 7-1/2 | 1200 | 254T | 89 | 73 |
| 10 | 1200 | 256T | 89 | 74 |
| 15 | 1200 | 284T | 90 | 77 |
| 20 | 1200 | 286T | 90 | 78 |
| 25 | 1200 | 324T | 91 | 74 |
| 1 | 1800 | 143T | 82 | 84 |
| 1-1/2 | 1800 | 145T | 84 | 85 |

| HP | RPM (Syn) | NEMA Frame | Minimum Percent Efficiency | Minimum Percent Power Factor |
|---|---|---|---|---|
| 2 | 1800 | 145T | 84 | 85 |
| 3 | 1800 | 182T | 86 | 86 |
| 5 | 1800 | 184T | 87 | 87 |
| 7-1/2 | 1800 | 213T | 88 | 86 |
| 10 | 1800 | 215T | 89 | 85 |
| 15 | 1800 | 256T | 91 | 85 |
| 20 | 1800 | 256T | 91 | 86 |
| 25 | 1800 | 284T | 91 | 85 |
| 1-1/2 | 3600 | 143T | 82 | 85 |
| 2 | 3600 | 145T | 82 | 87 |
| 3 | 3600 | 145T | 84 | 85 |
| 5 | 3600 | 182T | 85 | 86 |
| 7-1/2 | 3600 | 184T | 86 | 88 |
| 10 | 3600 | 213T | 87 | 86 |
| 15 | 3600 | 215T | 89 | 89 |

| | | | | |
|---|---|---|---|---|
| 20 | 3600 | 254T | 90 | 89 |
| 25 | 3600 | 256T | 90 | 92 |

**2.10 PERFORMANCE SCHEDULE, THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED**

| HP | RPM (Syn) | NEMA Frame | Minimum Percent Efficiency | Minimum Percent Power Factor |
|---|---|---|---|---|
| 1 | 1200 | 145T | 81 | 72 |

| HP | RPM (Syn) | NEMA Frame | Minimum Percent Efficiency | Minimum Percent Power Factor |
|---|---|---|---|---|
| 1-1/2 | 1200 | 182T | 83 | 65 |
| 2 | 1200 | 184T | 85 | 68 |
| 3 | 1200 | 213T | 85 | 63 |
| 5 | 1200 | 215T | 86 | 66 |
| 7-1/2 | 1200 | 254T | 89 | 68 |
| 10 | 1200 | 256T | 89 | 75 |
| 15 | 1200 | 284T | 90 | 72 |
| 20 | 1200 | 286T | 90 | 76 |
| 25 | 1200 | 324T | 90 | 71 |
| 1 | 1800 | 143T | 82 | 84 |
| 1-1/2 | 1800 | 145T | 84 | 85 |
| 2 | 1800 | 145T | 84 | 85 |
| 3 | 1800 | 182T | 87 | 83 |
| 5 | 1800 | 184T | 88 | 83 |
| 7-1/2 | 1800 | 213T | 89 | 85 |
| 10 | 1800 | 215T | 90 | 84 |
| 15 | 1800 | 254T | 91 | 86 |

| | | | | |
|---|---|---|---|---|
| 20 | 1800 | 256T | 91 | 85 |
| 25 | 1800 | 284T | 92 | 84 |
| 1-1/2 | 3600 | 143T | 82 | 85 |
| 2 | 3600 | 145T | 82 | 87 |
| 3 | 3600 | 182T | 82 | 87 |
| 5 | 3600 | 184T | 85 | 88 |
| 7-1/2 | 3600 | 213T | 86 | 86 |
| 10 | 3600 | 215T | 86 | 86 |

| HP | RPM (Syn) | NEMA Frame | Minimum Percent Efficiency | Minimum Percent Power Factor |
|---|---|---|---|---|
| 15 | 3600 | 254T | 88 | 91 |
| 20 | 3600 | 256T | 89 | 89 |
| 25 | 3600 | 284T | 90 | 92 |

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. The CONTRACTOR shall install the equipment in strict accordance with the Contract Documents and the equipment manufacturer's recommendations.

B. Install motors securely on a firm foundation. Mount ball bearing motors with shaft in approved position.

C. Check line voltage and phase to verify data on nameplate.

**END OF SECTION**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**

**SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. This section includes the following:

1. Gages.

**1.2 DEFINITIONS**

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

**1.3 SUBMITTALS**

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for gages indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of gage, signed by product manufacturer.

D. Operation and Maintenance Data: For Gages to include in emergency, operation, and maintenance manuals.

**1.4 BASIS OF PAYMENT**

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION WORK.

**PART 2 - PRODUCTS**

**2.1 PRESSURE GAGES**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back- outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass.
8. Ring: Metal.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion- resistant, porous-metal disc of material suitable for system fluid and working pressure.

## PART 3 - EXECUTION

### 3.1 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure- reducing valve.

### 3.2 INSTALLATIONS

A. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

B. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.

C. Install flow indicators, in accessible positions for easy viewing, in piping systems.

### 3.3 CONNECTIONS

A. Install gages adjacent to machines and equipment to allow service and maintenance for gages, machines, and equipment.

### 3.4 ADJUSTING

A. Adjust faces of gages to proper angle for best visibility.

**END OF SECTION**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**

**SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. This section includes the following:

1. Hangers and Supports - Pipe and Equipment
2. Inserts, Shields & Beam Clamps
3. Sleeves and Seals
4. Miscellaneous Support Items
5. Hangers and Supports – Ductwork

**1.2 RELATED WORK**

A. Division 3 - Cast-in-Place Concrete

B. Division 7 - Thermal and Moisture Protection

C. Division 23 - HVAC Insulation, Section 23 07 00

D. Division 23 – Instrumentation and Control for HVAC, Section 23 09 00

E. Division 23 – Facility Natural-Gas Piping, Section 23 11 23

F. Division 23 – Metal Ducts, Section 23 31 13

**1.3 REFERENCES**

A. As a minimum, meet the requirements of the following codes and standards.

1. The City of Lake Forest Building Code applies to all construction with the City of Lake Forest limits
2. ASME B31.2 - Fuel Gas Piping
3. ASTM F708 - Design and Installation of Rigid Pipe Hangers
4. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer
5. MSS SP69 - Pipe Hangers and Supports - Selection and Application
6. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices
7. SMACNA 15D - HVAC Metal Duct Standards

**1.4 SUBMITTALS**

A. Refer to the Basic Mechanical Requirements Section, 23 05 03.

B. Common Work Results for HVAC Section 23 05 00.

C. Shop Drawings: Indicate system layout with locations and details of supports and

hangers. Submit Shop Drawings for each type of support and hanger, indicating dimensions, weights, required clearances, and methods of assembly.

D. Product Data:

1. Provide manufacturers catalog data, including load capacity.
2. Maintenance data for supports and anchors for inclusion in operating and maintenance manuals. Indicate special procedures and assembly of components. State load carrying capacity of trapeze, multiple pipe, and riser support hangers.
3. Flexible pipe connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

## 1.5 QUALITY ASSURANCE

A. Refer to the Basic Mechanical Requirements Section, 23 05 03.

B. Qualify welding processes and welding operators in accordance with AWS D1.1, Structural Welding Code - Steel. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

E. Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections, allowed by ASME B31.9, Building Services Piping Code, are not exceeded.

F. CONTRACTOR Qualifications: Installation of supporting equipment and accessories must be performed only by a qualified installer. The term qualified means experienced in performing the work required by this Section. The qualified installer will be responsible for demonstrating to the OWNER'S satisfaction that he/she has sufficient experience in its role. The installer must submit evidence of such qualifications upon request by the OWNER.

G. Manufacturer Qualifications: Fabrication of supporting equipment and accessories must be performed only by a qualified fabricator. The term qualified means experienced in performing the work required by this Section. The qualified fabricator will be responsible for demonstrating to the OWNER'S satisfaction that he/she has sufficient experience in its role. The qualified fabricator must submit evidence of such qualifications upon request by the OWNER.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to the Basic Mechanical Requirements Section, 23 05 03.

B. Deliver materials to site in factory packing with shipping bars and positioning devices intact.

C. Protect equipment from exposure by leaving coverings, pipe-end protection and packaging in place until installation.

## 1.7 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION WORK.

## PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:

1. Hangers and Supports

    a. Manufacturer's:

        1) Grinnell
        2) B-Line
        3) Carpenter
        4) PHD Manufacturing

2. Inserts, Shields, & Beam Clamps

    a. Manufacturer's:

        1) Grinnell
        2) B-Line
        3) Carpenter
        4) PHD Manufacturing

B. The design of this project, including all plans, drawings, and construction details, is based on the stated manufacturer's model numbers. If the CONTRACTOR intends to provide items or equipment from any of the other acceptable manufacturers listed in the Contract Documents, then the CONTRACTOR shall be responsible for the cost of any and all work, including, but not limited to additional design, engineering, labor, material, equipment and incidental costs, necessary to accommodate such items or equipment for this project.

C. Any and all work that may be required to accommodate any items or equipment of the other acceptable manufacturers listed in the Contract Documents is, without limitation, subject to the review of the ENGINEER.

## 2.2 GENERAL REQUIREMENTS

A. Drive screws, pins, studs, etc., of the type secured by explosive force shall not be used for securing any of the hangers, or other supporting members.

B. End reactions transmitted to rotating equipment, such as pumps, may deform the equipment case and cause bearing misalignment. Follow manufacturer's recommendations for allowable forces and movements that may be placed on their equipment.

C. Anchor reaction forces must be accounted for when designing supports for piping, anchors, and guides. Pipe anchors shall be constructed so that the entire circumference of the pipe is clamped. A straight run of pipe is not to be anchored at both ends.

D. Hangers installed outdoors shall have two coats of rust inhibitor paint after installation and adjustment. Prime coat exposed steel hangers and supports. Hangers and supports located in pipe shafts, and suspended ceiling spaces are not considered to be exposed.

## 2.3 HANGERS AND SUPPORTS - DUCTWORK

A. Horizontal steel ductwork shall be supported by hot dipped galvanized flat steel stock, or round steel rod of sizes specified. Round steel rods to be electrogalvanized all-thread rod of ASTM A36 steel. Hangers to be provided at both sides of flat sided ductwork for the full height of duct. Round ductwork to be provided with a band of the same size as the hanger to completely encircle the duct. Band is to be secured to the hanger by means of a 3/8" bolt (min.).

B. Horizontal steel ductwork shall be supported in accordance with the following table. See SMACNA HVAC Construction Standards for more details.

**Flat Sided Ductwork Minimum Hanger Size**

| Maximum Half of Duct Perimeter - | Pair at 10 ft. Spacing | | Pair at 8 ft. Spacing | | Pair at 5 ft. Spacing | | Pair at 4 ft. | |
|---|---|---|---|---|---|---|---|---|
| | Rod | Galvan. Steel Strap | Rod | Galvan. Steel Strap | Rod | Galvan. Steel Strap | Rod | Galvan. Steel Strap |
| $\frac{P}{2}$ = 30" | 3/8" | 1"x22 Ga. | 1/4" | 1"x22 Ga. | 1/4" | 1"x22 Ga. | 1/4" | 1"x22 Ga. |
| $\frac{P}{2}$ = 72" | 3/8" | 1"x18 Ga. | 1/4" | 1"x20 Ga. | 1/4" | 1"x22 Ga. | 1/4" | 1"x22 Ga. |
| $\frac{P}{2}$ = 96" | 3/8" | 1"x16 Ga. | 3/8" | 1"x18 Ga. | 3/8" | 1"x20 Ga. | 1/4" | 1"x22 Ga. |
| $\frac{P}{2}$ = 120" | ½" | 1-1/2"x16 Ga. | 3/8" | 1"x16 Ga. | 3/8" | 1"x18 Ga. | 1/4" | 1"x20 Ga. |
| $\frac{P}{2}$ = 168" | ½" | 1-1/2"x16 Ga. | ½" | 1-1/2"x16 Ga. | 3/8" | 1"x16 Ga. | 3/8" | 1"x18 Ga. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\frac{P}{2}$ =192" | ½" | --- | ½" | 1-1/2"x16 Ga. | 3/8" | 1"x16 Ga. | 3/8" | 1"x16 Ga. |
| $\frac{P}{2}$ = 193" | Special Analysis | | | | | | | |

| **Round Duct Minimum Hanger Size** | | | |
|---|---|---|---|
| Duct Diameter | Maximum Spacing | Galvanized Steel Rods | Galvanized Steel Strap |
| 10" dn | 12' | 1/4" | 1"x22 Ga. |
| 11-18" | 12' | 1/4" | 1"x22 Ga. |
| 19-24" | 12' | 1/4" | 1"x22 Ga. |
| 25-36" | 12' | 3/8" | 1"x20 Ga. |
| 37-50" | 12' | Two 3/8" | Two 1"x20 Ga. |
| 51-60" | 12' | Two 3/8" | Two 1"x18 Ga. |
| 61-84" | 12' | Two 3/8" | Two 1"x16 Ga. |

| **Single Hanger Maximum** | | | |
|---|---|---|---|
| Rod Diam. | | Galvan. Strap | |
| 1/4" | 270 lbs. | 1"x22 Ga. | 260 lbs. |
| 3/8" | 680 lbs. | 1"x20 Ga. | 320 lbs. |
| ½" | 1250 lbs. | 1"x18 Ga. | 420 lbs. |
| 5/8" | 2000 lbs. | 1"x16 Ga. | 700 lbs. |
| 3/4" | 3000 lbs. | 1-1/2"x16 Ga. | 1100 lbs. |

D. Vertical ducts through floor slabs shall be supported at each floor on two sides by hot dipped galvanized angles bolted to the duct and resting on the floor slab. Supporting angles to be bolted to the floor, ceiling, or wall to prevent vibration and to be 1-1/2 inch x 1-1/2 inch x 1/8 inch for ducts over 48 inches wide. In open shafts, additional structural members to be provided to span openings for support of ducts and angles at each floor. Ducts along walls to have supports spaced not more than eight feet apart.

E. Provide hangers at the center of every elbows or change in direction of horizontal ductwork.

F. Provide all necessary supplementary steel for proper support or attachment of hangers.

Steel shall be painted with one coat of rust-inhibiting primer.

G. Wire or perforated hangers are not permitted.

## 2.4 HANGERS AND SUPPORTS - PIPING

A. Provide adjustable hangers, inserts, brackets, rolls, clamps, supplementary steel, etc., as required for proper support of all pipelines and equipment. Steel shall be painted with one coat of rust-inhibiting primer. Pipe supports located outdoors to be hot-dip galvanized with hot-dip galvanized or stainless steel hardware.

B. Hangers shall be designed to allow for expansion and contraction of pipelines.

C. Unless specifically stated otherwise for the service of the piping, hangers shall be of adequate size to permit insulation covering to run continuously through hangers. Refer to Section 230700, HVAC Insulation.

D. The following piping systems shall be supported by clevis hanger similar to Grinnell 260 or PHD 450. Insulation, if required, shall be installed continuous through hangers except for waste lines. Install wood blocks, high density insulation inserts, or steel saddles as stated elsewhere in this specification section.

E. Other Piping Support Requirements

1. No strap or perforated strap hangers shall be permitted in any piping work.
2. All vertical riser pipes shall be supported at every floor by heavy wrought iron clamps or collars anchored to construction.
3. Additional hangers shall be provided at all valve assemblies, automatic valves, bypasses, or elsewhere where required to properly support any additional pipe loadings
4. Nuts used in pipe hanger assemblies shall be hexagon, semi-finished American Standard, Coarse Series. Hangers shall be secured to rod pendants with two nuts and they shall be jamb locked after hanger. Trim rods flush with nuts after hanger is secured and leveled. Nuts and fasteners shall be not dipped galvanized.

F. The following Table shall be followed unless specified otherwise. Hanger rods shall be of hot drawn cadmium plated solid or threaded carbon steel of the following sizes.

| Pipe Size Inches | Hanger Rod Diameter |
|---|---|
| ½ to 2 | 3/8 |
| 2-1/2 to 3 | ½ |

| Pipe Size Inches | Hanger Rod Diameter |
|---|---|
| 4 to 5 | 5/8 |

| | |
|---|---|
| 6 | 3/4 |
| 8 to 12 | 7/8 |

G. For horizontal steel pipe maximum hanger spacing shall be as listed below, unless stated otherwise.

| **Nominal Size, Inches** | **Max. Hanger Spacing, Feet** |
|---|---|
| 1-1/4 and less | 7 |
| 1-1/2 | 9 |
| 2 | 10 |
| 2-1/2 | 11 |
| 3 | 12 |
| 3-1/2 | 13 |
| 4 | 14 |
| 5 | 16 |
| 6 | 17 |
| 8 | 19 |

H. Regardless of any of the listed hanger spacings, provide a hanger/support at each change in direction of piping, each drop and/or rise to every piece of equipment, and each valve larger than 2" or any other type of fitting of significant weight.

## 2.5 HANGER SUPPORTS - DRILLED-IN INSERTS AND BEAM CLAMPS

A. Where piping and equipment is to be suspended from poured concrete construction, provide concrete inserts in the form work.

B. Inserts installed after slabs have been poured shall be drilled-in, threaded type similar to Phillips Drill Co., “Red Head Self-Drilling Expansion Shields,” Ackerman-Johnson, “Self-Drilling Anchors,” or Diamond Expansion Bolt Co., “Blue-Cut Self-Drilling Anchors.” The use of lead shield anchors, anchors which utilize lead parts, and powder-actuated fasteners is not permitted.

C. For each hanger supporting piping or ductwork suspended from structural steel members, provide similar to Grinnell Fig. 133 or PHD 610 or Grinnell Fig. 134 or PHD 620 beam clamps as required by loading.

D. Inserts shall have malleable iron case of galvanized steel shell and expander plug for

threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms. Size inserts to suit threaded hanger rods.

## 2.6 SLEEVES

A. Piping sleeves through floors shall be fabricated from 16 gauge galvanized sheet steel and shall be ½" larger inside diameter than pipe or pipe with covering passing through sleeves. Sleeves shall be of length required for a 4" wide collar (waterstop) welded to the sleeve, placed on top of structural slab. Sleeve openings through floor slab shall be core drilled, using proper sized drill to assure a minimum clearance between opening and outside diameter of sleeve. Calk sleeves in place, watertight with silicone sealant. Bottom of sleeves shall be flush with bottom surface and top of sleeve extended 1" above finished floor.

B. Wall Sleeves

1. Concrete walls: Standard weight galvanized steel pipe, flush with wall surface at both ends.

    a. Sleeves for uninsulated piping shall be 2 sizes larger than pipe passing through.
    b. Sleeves for insulated piping shall be large enough to accommodate the full thickness of the pipe covering with clearance for expansion and contraction.
    c. Unless indicated otherwise, annular space between interior surfaces of all pipes and sleeves and all sleeves and ducts shall be packed with similar to Schuller "Cere-Fibre," "Super 48 Insulating Cement."

C. Round and Oval Ductwork Sleeves

1. Sleeves for round ductwork, 5 inches and larger, which pass through walls, partitions, or floors shall be 18 gauge galvanized steel. Sleeves, except as hereinafter specified, shall be finished flush with surface at both ends of sleeves.
2. Floor sleeves in equipment rooms, over habitable spaces, shall extend 2 inches above finished floor.
3. Sleeves shall be of sufficient size to pass the full specified thickness of insulation except where located in fire-rated walls or floors.
4. Spaces between round ductwork and fire-rated walls, partitions, and floor sleeves shall be sealed as specified elsewhere in these specifications.

# PART 3 - EXECUTION

## 3.1 GENERAL REQUIREMENTS

A. Examine substrates and conditions under which supports and anchors are to be installed. Do not proceed with installing until unsatisfactory conditions have been corrected.

B. All structural steel used in the fabrication of pipe supports, including cross members, steel shapes and plates, shall conform to ASTM Specification A-36. Steel shall be well-

formed to shape and size. Shearing and punching shall leave clean, true lines to surfaces. Carefully match exposed work to produce continually of line and design. All joints shall be accurately fitted and rigidly secured with hairline contact.

C. All rigid hangers shall provide a means of vertical adjustment after installation.

E. When clamps are used to support vertical lines, shear lugs shall be welded to the pipe to prevent slippage.

F. Damaged zinc coatings on galvanized steel shall be repaired as required to maintain corrosion resistance as if undamaged.

**3.2 METAL FABRICATION**

A. Field welding shall comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance, and quality of welds made, and methods used in correcting welding work.

B. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports.

C. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop-welded because of shipping size limitations.

**3.3 ANCHORS**

A. All connections to mains shall be made adjacent to anchors, where possible.

B. Install anchors at proper locations as necessary to prevent stresses from exceeding those permitted by ASME B31.1 and to prevent transfer of loading and stresses to connected equipment.

C. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.1 and AWS D1.1.

D. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

**3.4 ADJUSTMENTS**

A. Adjust hangers to distribute loads equally and to achieve indicated slope of pipe.

B. Provide grout under supports so as to bring piping and equipment to proper levels and elevations.

**END OF SECTION 23 05 29**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**

**SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. This Section includes the following:

1. Spring hangers.

**1.2 DEFINITIONS**

A. IBC: International Building Code.

**1.3 SUBMITTALS**

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

C. Coordination Drawings: Show coordination for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports.

D. Field quality-control test reports.

**1.4 QUALITY ASSURANCE**

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

**1.5 BASIS OF PAYMENT**

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION WORK.

**PART 2 - PRODUCTS**

**2.1 VIBRATION ISOLATORS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control.
2. Mason Industries.

3. Vibration Mountings & Controls, Inc.

B. Spring Hangers Type F: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel- washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and - tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanized metal components.
3. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 APPLICATIONS

A. Spring Hangers: Install spring hangers where indicated or scheduled on Drawings to receive them.

## 3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Attachment to Structure: If specific attachment is not indicated, anchor bracing to

structure flanges of beams, at upper truss chords of bar joists, or at concrete members.

## 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing person acceptable to OWNER.
2. Schedule test with OWNER before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain OWNER'S approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by OWNER.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

## 3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

## 3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train OWNER'S maintenance personnel to adjust, operate, and maintain air-mounting systems.

**END OF SECTION 23 05 48**

## DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING

## SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.01 SUMMARY

A. This section includes the following:

1. HVAC Equipment labels.
2. Warning signs and labels.
3. Gas Pipe labels.
4. Duct labels.
5. Stencils.
6. Gas Valve tags.
7. Warning tags.

### 1.02 ACTION SUBMITTAL

A. Product Data: For each type of product indicated.

B. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

### 1.03 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION WORK.

## PART 2 - PRODUCTS

### 2.01 HVAC EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with

substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8- 1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.02 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.03 GAS PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color- coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent- adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

## 2.04 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White Yellow.

C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

## 2.05 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

## 2.06 GAS VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

## 2.07 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

# PART 3 - EXECUTION

## 3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

## 3.02 HVAC EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

## 3.03 GAS PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

C. Pipe Label Color Schedule: Provide colors per ANSI/ASME A13.1.

## 3.04 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed.

## 3.05 GAS VALVE-TAG INSTALLATION

A. Install tags on shutoff valves and pressure regulators in gas piping system.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Gas: 1-1/2 inches, round.

2. Valve-Tag Color:

   a. Gas: Yellow.

3. Letter Color:

   a. Gas: White.

## 3.06 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 23 05 53**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**
**SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 INFORMATIONAL SUBMITTALS

A. Certified TAB reports.

1.4 QUALITY ASSURANCE

A. TAB CONTRACTOR Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB CONTRACTOR and certified by AABC NEBB or TABB.
2. TAB Technician: Employee of the TAB CONTRACTOR and who is certified by AABC NEBB or TABB as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB CONTRACTOR'S forms approved by Architect.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

A. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.5 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, fittings and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine operating safety interlocks and controls on HVAC equipment.

J. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

K. Balancing CONTRACTOR to work with temperature CONTRACTOR and HVAC CONTRACTOR to verify correct operation of entire HVAC system before submitting the report.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance dampers are open.
5. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

C. Mark equipment and balancing devices, including damper-control positions, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in ventilation operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

## 3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

## 3.7 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

## 3.8 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing ENGINEER.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB CONTRACTOR.
3. Project name.
4. Project location.
5. Architect's name and address.
6. ENGINEER'S name and address.
7. CONTRACTOR'S name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.

    b. Notable characteristics of systems.

    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor and exhaust-air dampers.

    b. Fan drive settings including settings and percentage of maximum pitch diameter.

    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Position of balancing devices.

**END OF SECTION 23 05 93**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**

**SECTION 23 07 00 - HVAC INSULATION**

**PART 1 - GENERAL**

1.1 SUMMARY

a. Section includes the following materials and accessories for insulating HVAC equipment and piping that is not factory insulated:

(1) Insulation Materials:

a) Calcium silicate.
b) Cellular glass.

(2) Insulating cements.
(3) Adhesives.
(4) Mastics.
(5) Lagging adhesives.
(6) Sealants.
(7) Field-applied jackets.
(8) Tapes.
(9) Securements.
(10) Corner angles.

1.2 DEFINITIONS

a. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.

b. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.

c. Cold Surfaces: Normal operating temperatures less than 75 deg F.

d. Thermal Resistivity: "R-values" represent the reciprocal of thermal conductivity (K-value). Thermal conductivity is the rate of heat flow through a homogeneous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.

1.3 SUBMITTALS

a. Product Data: For each type of product indicated. Include thermal conductivity, thermal resistivity (R-value), thickness, and jackets (both factory and field applied, if any).

b. Shop Drawings:

(1) Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

(2) Detail attachment and covering of heat tracing, if any, inside insulation.
(3) Detail insulation application at pipe expansion joints for each type of insulation.
(4) Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
(5) Detail removable insulation at piping specialties, equipment connections, and access panels.
(6) Detail application of field-applied jackets.
(7) Detail application of identification
(8) Detail application at linkages of control devices.
(9) Detail field application for each equipment type.
(10) Detail outdoor duct insulation installation.

c. Samples: For each type of insulation jacket and identification indicated. Identify each Sample, describing product and intended use.

(1) Sample Sizes:

a) Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
b) Sheet Form Insulation Materials: 12 inches square.
c) Jacket Materials for Pipe: 12 inches long by NPS 2.
d) Sheet Jacket Materials: 12 inches square.
e) Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

d. Material Test Reports: From a qualified testing agency acceptable to the authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests and test methods employed.

e. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

a. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

b. Regulatory Requirements: Insulation installations shall comply with the Illinois Energy Conservation Code. Where conflicts exist between the codes identified above and this section, the more stringent requirement shall apply.

c. Surface-Burning Characteristics: Except where indicated otherwise, insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by UL or another testing and inspecting agency acceptable to the authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

(1) Insulation: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

a. Deliver materials to Project site in original packages and containers with seals unbroken and bearing manufacturer's original labels, including manufacturer's name, product name, and directions for storing, handling, and use. The delivery and storage of materials to project site shell be coordinated with ENGINEER and OWNER.

b. Store materials in a clean, dry, fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

(1) Remove damaged or wet insulation from Project site and dispose of legally.

1.6 COORDINATION

a. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section 230529 "Hangers and Supports for Piping and Equipment."

b. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork shop drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

a. Schedule insulation application after pressure testing systems and after installation and testing of heat tracing, if required for the Project. Insulation application may begin on segments that have satisfactory test results.

b. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.8 BASIS OF PAYMENT

a. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION WORK.

**PART 2 - PRODUCTS**

1.1 INSULATION – GENERAL

a. Products shall not contain asbestos, lead, mercury, or mercury compounds.

b. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

1.2 INSULATION MATERIALS

A. CALCIUM Silicate Insulation:

(1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Industrial Insulation Group, LLC (IIG) Thermo-12 Gold.

(2) Properties:

a) Compressive Strength: ASTM C 165; 100 psi, minimum, at 5 percent deformation.
b) Dry Density, Average: ASTM C 302; 14.0 pcf, minimum.
c) Fire-Test-Response Characteristics: ASTM E 84; flame spread index of 0 and smoke developed index of 0, as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to the authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency. Average thermal conductivity of 0.45 Btu/Hr/Sq.Ft/deg. F at 200 degrees mean temperature per inch thickness.

(3) Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
(4) Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

B. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cell-U-Foam Corporation; Ultra-CUF.
b. Pittsburgh Corning Corporation; Foamglas Super K.
c. Specialty Products & Insulation

2. Block Insulation: ASTM C 552, Type I.

3. Special-Shaped Insulation: ASTM C 552, Type III.

4. Board Insulation: ASTM C 552, Type IV.

5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.

7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

1.3 INSULATING CEMENTS

a. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

(1) Products: Subject to compliance with requirements, provide one of the following:

a) Insulco, Division of MFS, Inc.; Triple I.
b) Ramco Insulation, Inc.; Supertemp 1900 / PKI Super-Stik.

b. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

(1) Products: Subject to compliance with requirements, provide one of the following:

a) Insulco, Division of MFS, Inc.; SmoothKote.
b) Ramco Insulation, Inc.; Ramcote 1200 / PKI Quik Cote.

1.4 ADHESIVES

A. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

(2) Products: Subject to compliance with requirements, provide one of the following:

a) Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
b) Eagle Bridges - Marathon Industries; 290.
c) Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
d) Vimasco Corporation; 760.

B. Cellular-Glass Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Products, Division of ITW; CP-96.
b. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1.5 MASTICS

a. Description: Comply with MIL-PRF-19565C, Type II. Materials shall be compatible with insulation materials, jackets, and substrates.

(1) VOC Limits: For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

(1) Products: Subject to compliance with requirements, provide one of the following:

a) Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b) Vimasco Corporation; 749.

(2) Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
(3) Service Temperature Range: Minus 20 to plus 180 deg F
(4) Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
(5) Color: White.

1.6 LAGGING ADHESIVES

a. Description: Comply with MIL-A-3316C, Class I, Grade A. Materials shall be compatible with insulation materials, jackets, and substrates.

(1) VOC Limits: For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
(2) Products: Subject to compliance with requirements, provide one of the following:

a) Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b) Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c) Vimasco Corporation; 713 and 714.

(3) Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
(4) Service Temperature Range: Minus 50 to plus 180 deg F.
(5) Color: White.

1.7 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Sealants for Metal Jacket Flashing:

(6) Products: Subject to compliance with requirements, provide one of the following:

a) Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b) Eagle Bridges – Marathon Industries; 405.
c) Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d) Pittsburg Corning PC 727.

(7) Sealants shall be compatible with insulation materials, jackets, and substrates.
(8) Sealants shall be fire- and water-resistant, permanently flexible, elastomeric sealant.
(9) Service Temperature Range: -40 deg F to +250 deg F
(10) Color: Aluminum.

1.8 JACKETS

a. Field-Applied Jackets: Comply with ASTM C 921, Type I, unless otherwise indicated. Field-applied jackets shall be provided on all piping below 8 ft. height.

(1) Metal Jackets:

a) Products: Subject to compliance with requirements, provide one of the following:

1 Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
2 ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
3 RPR Products, Inc.; Insul-Mate.

b) Stainless-Steel Jackets: ASTM A 167 or ASTM A 240.

1 Sheet and roll stock ready for shop or field sizing.
2 Material, finish, and thickness are indicated in field-applied jacket schedules.
3 Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

4 Moisture Barrier for Outdoor Applications: 3-mil-thick heat-bonded polyethylene and kraft paper.

5 Factory-Fabricated Fitting Covers: Fabricated from the same material, finish, and thickness as jacket. Provide factory-fabricated covers for preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows; tee covers; flange and union covers; end caps; beveled collars; and valve covers. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

1.9 TAPES

a. Aluminum Foil Tape: vapor-retarder tape with acrylic adhesive.

(1) Products: Subject to compliance with requirements, provide one of the following:

a) Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b) Compac Corporation; 120.
c) Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d) Venture Tape; 3520 CW.

(2) Width: 3 inches.
(3) Thickness: 3.7 mils.
(4) Adhesion: 100 ounces force/inch in width.
(5) Elongation: 5 percent.
(6) Tensile Strength: 34 lbf/inch in width.

1.10 SECUREMENTS

a. Bands:

(1) Products: Subject to compliance with requirements, provide one of the following:

a) ITW Insulation Systems; Gerrard Strapping and Seals.
b) RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

(2) Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.020-inch thick, 3/4-inch wide with wing seal or closed seal.

a) Type 304 for interior installations.
b) Type 316 for exterior installations, and interior installations subject to high humidity.

(3) Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

b. Insulation Pins and Hangers:

(1) Capacitor-Discharge-Weld Pins: Copper- coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

a) Products: Subject to compliance with requirements, provide one of the following:

1 AGM Industries, Inc.; CWP-1.
2 GEMCO; CD.
3 Midwest Fasteners, Inc.; CD.
4 Nelson Stud Welding; TPA, TPC, and TPS.

(2) Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a) Products: Subject to compliance with requirements, provide one of the following:

1 AGM Industries, Inc.; CHP-1.
2 GEMCO; Cupped Head Weld Pin.
3 Midwest Fasteners, Inc.; Cupped Head.
4 Nelson Stud Welding; CHP.

(3) Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following:

a) Products: Subject to compliance with requirements, provide one of the following:

1 AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
2 GEMCO; Perforated Base.
3 Midwest Fasteners, Inc.; Spindle.

b) Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c) Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
d) Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

c. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

d. Wire: 0.062-inch soft-annealed, stainless steel.

1.11 CORNER ANGLES

a. Stainless-Steel Corner Angles: 0.024-inch thick, minimum 1-inch by 1-inch, stainless steel according to ASTM A 167 or ASTM A 240, Type 304 or Type 316.

## PART 3 - EXECUTION

1.1 EXAMINATION

a. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

(1) Verify that systems and equipment to be insulated have been tested and are free of defects.
(2) Verify that surfaces to be insulated are clean and dry.

b. Proceed with installation only after unsatisfactory conditions have been corrected.

1.2 PREPARATION

a. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

b. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

1.3 INSTALLATION – GENERAL

a. Install insulation materials, accessories, and finishes according to the manufacturer's written instructions with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

b. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system specified.

c. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

d. Keep insulation materials dry during application and finishing.

e. Install insulation with least number of joints practical.

f. Install insulation with longitudinal seams at top and bottom of horizontal runs.

g. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

h. Install multiple layers of insulation with longitudinal and end seams staggered.

i. Install vapor barriers on insulated pipes, ductwork, and equipment having surface operating temperatures below 60 deg F.

j. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

k. Where vapor barrier is indicated or required, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic. Staples are not acceptable.

(1) Install insulation continuously through hangers and around anchor attachments.
(2) For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
(3) Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
(4) Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, or shield.

l. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

m. Install insulation with factory-applied jackets as follows:

(1) Draw jacket tight and smooth.
(2) Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
(3) Install insulation with longitudinal seams at bottom of pipe. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

a) For below ambient services, apply vapor-barrier mastic over staples as required to maintain continuity of vapor barrier.
b) Do not staple longitudinal laps on insulation applied to piping systems with a surface temperature at or below 35 deg F.

(4) Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
(5) Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
(6) At penetrations in jackets for thermometers, and pressure gages, fill and seal voids with vapor barrier coating.

n. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

o. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

p. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

q. For above ambient services, do not install insulation to the following:

(1) Vibration-control devices.
(2) Testing agency labels and stamps.
(3) Nameplates and data plates.
(4) Manholes.
(5) Handholes.
(6) Cleanouts.

1.4 PENETRATIONS

a. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

(1) Seal penetrations with flashing sealant.
(2) For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
(3) Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
(4) Seal jacket to roof flashing with flashing sealant.

1.5 INSTALLATION OF CALCIUM SILICATE INSULATION

a. Insulation Installation on Straight Pipes and Tubes:

(1) Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
(2) Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
(3) Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Apply a thin finish coat to achieve smooth, uniform finish.

b. Insulation Installation on Pipe Flanges:

(1) Install preformed pipe insulation to outer diameter of pipe flange.
(2) Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
(3) Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
(4) Finish flange insulation same as pipe insulation.

c. Insulation Installation on Pipe Fittings and Elbows:

(1) Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
(2) When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with stainless steel wire.
(3) Finish fittings insulation same as pipe insulation.

d. Metal Jacket: Where indicated, apply metal jacket over finished insulation as specified in this Section for installation of metal jackets.

1.6 MINERAL-FIBER INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor- barrier mastic applied

in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat- oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain

vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor- barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

1.7 FIELD-APPLIED JACKET INSTALLATION

a. Where stainless steel or aluminum jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Longitudinal seams shall be overlapped to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands on 12-inch centers and at end joints.

1.8 LABELING AND IDENTIFYING INSTALLATION

a. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

(1) Plastic markers with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.

a) Fasten markers on pipes smaller than 6-inch diameter by one of following methods:

1 Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2 Adhesive lap joint in pipe marker overlap.
3 Laminated or bonded application of pipe marker to pipe (or insulation).
4 Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide, lapped 1-1/2 inches minimum at both ends of pipe marker, and covering full circumference of pipe.

b) Fasten markers on pipes 6-inch and larger diameter by one of following methods:

1 Laminated or bonded application of pipe marker to pipe (or insulation).
2 Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2-inches wide, lapped 3 inches minimum at both ends of pipe marker, and covering full circumference of pipe.

3 Strapped to pipe (or insulation) with manufacturer's standard stainless steel bands.

(2) Locate pipe markers and color bands as follows wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

a) Near each valve and control device.
b) Near each branch connection, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
c) Near penetrations through walls, floors, ceilings, or enter non-accessible enclosures.
d) At access doors, manholes, and similar access points that permit view of concealed piping.
e) Near major equipment items and other points of origination and termination.
f) Spaced at a maximum of 50-feet o.c. along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
g) On piping above removable acoustical ceilings, except omit intermediately spaced markers.

1.9 FIELD QUALITY CONTROL

a. Testing Agency: CONTRACTOR shall engage a qualified testing agency to perform tests and inspections.

b. Tests and Inspections:

(1) Inspect field-insulated equipment, randomly selected by ENGINEER, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment requiring insulation for this project. For large equipment, remove only a portion adequate to determine compliance.
(2) Inspect pipe and fittings randomly selected by ENGINEER and OWNER, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe and three locations of welded fittings.

c. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. ENGINEER and OWNER may reject all work if sample work is found to be defective.

1.10 ENGINE GENERATOR EXHAUST INSULATION SCHEDULE

a. Emergency generator exhaust pipe and silencer insulation shall be the following:

(1) Calcium silicate: 2 inches thick.
(2) Install metal jacket over insulation material
(3) Do not insulate expansion devices in pipe.

1.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, exposed outside air plenum up to outside air damper.
2. Indoor, exposed exhaust air plenum up to exhaust air or relief air damper.

**END OF SECTION 23 07 00**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**

**SECTION 23 09 00 - INSTRUMENTATION, CONTROLS AND SEQUENCE OF OPERATIONS FOR HVAC EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY SCOPE OF WORK**

A. This Specification SECTION includes the temperature control and sequence of operation for HVAC systems and system components indicated on the Drawings and required by this Specification SECTION.

**1.02 RELATED SECTION**

A. SECTION 01 10 00 – SUMMARY

B. SECTION 23 05 00 – COMMON WORK RESULTS FOR HVAC

C. SECTION 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

D. SECTION 23 33 00 – DUCTWORK ACCESSORIES

E. SECTION 23 34 23 – HVAC POWER VENTILATORS

F. SECTION 23 82 39.16 – UNIT HEATERS

G. SECTION 26 05 10 – BASIC ELECTRICAL REQUIREMENTS

H. SECTION 40 94 23 – SCADA SYSTEM

**1.03 SUBMITTALS**

A. The CONTRACTOR must submit shop drawings indicating each HVAC system control and control system components.

B. Each submittal must be labeled with settings, adjustable range of control and limits and include written description of control sequence.

C. Each submittal must include diagrams for each control system, graphically depicting control logic.

D. Each submittal must include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

E. The CONTRACTOR must submit project record documents and must record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

**1.04 REFERENCES**

A. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. ASTM E1 - ASTM Thermometers.

C. NEMA DC3 - Low Voltage Room Thermostats.

D. NFPA - 90A - Installation of Air Conditioning and Ventilation Systems.

**1.05 DEFINITIONS**

A. Not Used.

**1.06 QUALITY ASSURANCE**

A. The CONTRACTOR must design the temperature control system under direct supervision of a Registered Professional ENGINEER experienced in design of this Work and licensed in the State of Illinois.

B. The shop drawings must be sealed by the Registered Professional ENGINEER.

**1.07 BASIS OF PAYMENT**

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION.

**PART 2 - PRODUCTS**

**2.01 THERMOSTATS**

A. Thermostats must be suitable for providing on-off control for heating and ventilation modes. Thermostats must be UL listed and rated for 120 volt, AC. Thermostats must have metal cover with wire guard. Temperature settings must be adjustable and visible.

B. The explosion proof thermostats shall be suitable for use in Class 1, Group D, Division 2 Hazardous environment, liquid filled, coiled bulb type element, SPDT cooling or heating application. The temperature adjustment range shall be 20-80 degree F with front of device dial.

C. The space thermostats shall be suitable for use in the electrical room with NEMA 4X corrosion resistant enclosure, coiled bulb type element, SPDT cooling or heating application. The temperature adjustment range shall be 30-100 degree F with front of device dial.

D. Manufacturers are to be Johnson Controls, Honeywell, Siemens Energy and Automation, or Barber Coleman.

**2.02 DAMPER OPERATORS**

A. The CONTRACTOR must provide damper operators with smooth, proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures.

B. The electric damper operators must be spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch and rated for 120 volt AC power. Power consumption shall not exceed 10 VA.

C. The CONTRACTOR must provide operators with sufficient power to move the device under all operating conditions plus 50 percent excess capacity.

D. The CONTRACTOR must provide all linkage and brackets required for mounting and attaching operators to device being operated.

E. Actuators shall be two-position (Open-Close). Actuators shall have visual position indicators and shall operate in sequence with other devices if required.

F. Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire range.

G. Actuator enclosure shall be NEMA 2 in the electrical room whereas in the dry and wet wells the enclosure shall be explosion proof NEMA 7 for use in Class 1 , Group D, Division 2 Hazardous environment.

H. Manufacturers are to be Belimo, Johnson Controls, Honeywell, or Siemens Energy.

**PART 3 - EXECUTION**

**3.01 DRY WELL (SF-1 and EF-1) AND (EUH-1, EUH-2 and EUH-3) SEQUENCE OF OPERATION**

A. Supply fan (SF-1), exhaust fan (EF-1) and outside air louver shall be controlled by H-O-A switch.

B. In the Auto Mode, motorized dampers (MOD 1 and MOD-2) shall open, upon proof of opening, supply fan (SF-1) and exhaust fan (EF-1) shall energize and run continuously under any of the following conditions:

1. When gas sensor detects combustible gas above setpoint within the pump room, fan shall remain on for an adjustable time period (5 minutes) upon clearing of alarm condition.

2. When room lights are energized.

C. In the Hand Mode, supply fan (SF-1) and exhaust fan (EF-1) run continuously and dampers (MOD-1 and MOD -2) are open.

D. In the OFF mode, supply fan (SF-1) and exhaust fan (EF-1) are OFF and dampers (MOD-1 and MOD-2) are closed.

E. Under all modes of operation, fire alarm signal shall disable all ventilation equipment.

F. Electric Unit Heaters EUH-1, EUH-1 and EUH-3 shall maintain a minimum of 50 degree Fahrenheit. Separate Wall mounted adjustable electric thermostat must be provided for each electric unit heater. Each thermostat must be wired to each electric unit heater.

**3.02 ELECTRICAL ROOM (SF-3) AND (EUH-4 and EUH-5) SYSTEM SEQUENCE OF OPERATION**

A. Supply fan (SF-3) and outside air louver shall be controlled by H-O-A switch and space cooling thermostat set to 85 degree F, adjustable.

B. In the Auto Mode, on call for cooling, motorized dampers (MOD-5 and MOD-6) shall open, upon proof of opening, supply fan (SF-3) shall energize and run continuously. Upon satisfaction of space cooling requirements, fan shall stop and dampers shall close.

C. In the Hand Mode, supply fan (SF-3) run continuously and dampers (MOD-5 and MOD -6) are open.

D. In OFF Mode, supply fan (SF-3) is OFF and dampers (MOD-5 and MOD-6) are closed.

E. Under all modes of operation, fire alarm signal shall disable all ventilation equipment.

F. Electric Unit Heaters EUH-4 and EUH-5 shall maintain a minimum of 70 degree Fahrenheit. Separate Wall mounted adjustable electric thermostat must be provided for each electric unit heater. Each thermostat must be wired to each electric unit heater.

**3.03 GENERATOR ROOM (EF-3) SEQUENCE OF OPERATION**

A. Exhaust fan (EF-3) shall be controlled manually to maintain space temperature.

**3.04 LOW LEVEL WET WELL (SF-2 and EF-2) SEQUENCE OF OPERATION**

A. Supply fan (SF-2), exhaust fan (EF-2) and outside air louver shall be controlled by H-O-A switch.

B. In the Auto Mode, motorized dampers (MOD-3 and MOD-4) shall open, upon proof of opening, supply fan (SF-2) and exhaust fan (EF-2) shall energize and run continuously under any of the following conditions:

1. When gas sensor detects combustible gas above setpoint within any lower level space room, fan shall remain on for an adjustable time period (5 minutes) upon clearing of alarm condition.

2. When room lights are energized.

C. In the Hand Mode, supply fan (SF-2) and exhaust fan (EF-2) run continuously and dampers (MOD-3 and MOD-4) are open.

D. In the OFF mode, supply fan (SF-2) and exhaust fan (EF-2) are OFF and dampers (MOD-3 and MOD-4) are closed.

E. Under all modes of operation, fire alarm signal shall disable all ventilation equipment.

**3.05 GRADE LEVEL WET WELL (EF-4) AND (EUH-6 and EUH-7) SEQUENCE OF**

**OPERATION**

A. Exhaust fan (EF-4) and outside air louver shall be controlled by H-O-A switch.

B. In the Auto Mode, motorized dampers (MOD-7 and MOD-8) shall open, upon proof of opening, exhaust fan (EF-4) shall energize and run continuously under any of the following conditions:

1. When gas sensor detects combustible gas above setpoint within the grade level room , fan shall remain on for an adjustable time period (5 minutes) upon clearing of alarm condition.

2. When room lights are energized.

C. In the Hand Mode, exhaust fan (EF-4) run continuously and dampers (MOD-7 and MOD-8) are open.

D. In the OFF mode, exhaust fan (EF-1) is OFF and dampers (MOD-7 and MOD-8) are closed.

E. Under all modes of operation, fire alarm signal shall disable all ventilation equipment.

F. Electric Unit Heaters EUH-6 and EUH-7 shall maintain a minimum of 50 degree Fahrenheit. Separate Wall mounted adjustable electric thermostat must be provided for each electric unit heater. Each thermostat must be wired to each electric unit heater.

**END OF SECTION 23 09 00**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**

**SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. This Section includes the following:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Grout.
7. Concrete bases.

**1.2 DEFINITIONS**

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

**1.3 PERFORMANCE REQUIREMENTS**

A. Natural-Gas System Pressure within Buildings: More than 0.5 psig but not more than 2 psig

**1.4 SUBMITTALS**

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.
6. Mechanical sleeve seals.
7. Escutcheons.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for

multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Coordination Drawings: Plans and details, drawn to scale, on which natural- gas piping is shown and coordinated with other installations, using input from installers of the items involved.

D. Welding certificates.

E. Field quality-control reports.

F. Operation and Maintenance Data.

## 1.5 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 1.8 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, GAS UTILITY SERVICE CONNECTION.

# PART 2 - PRODUCTS

## 2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

4. Protective Coating for Underground Piping: Factory-applied, three- layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

## 2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.

## 2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.4 MANUAL GAS SHUTOFF VALVES

A. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Lee Brass Company.
   b. McDonald, A. Y. Mfg. Co.
   c. NIBCO
   d. Hammond

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

## 2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Actaris.
   b. American Meter Company.
   c. Eclipse Combustion, Inc.
   d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   e. Invensys.
   f. Maxitrol Company.
   g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

## 2.6 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Watts Regulator Co.; Division of Watts
   f. Water Technologies, Inc.
   g. Wilkins; Zurn Plumbing Products Group.

2. Combination fitting of copper alloy and ferrous materials.

## 2.7 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile- iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## 2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

## 3.3 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade.
   1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

F. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

H. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 23 05 19 "Meters and Gages for HVAC Piping."

## 3.4 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

P. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Q. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

S. Do not use natural-gas piping as grounding electrode.

T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

U. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 23 05 19 "Meters and Gages for HVAC Piping."

V. Gas piping entering the building must be protected from accidental damages by vehicles, foundation settlement, or vibrations.

W. Gas Vent Pressure regulating values and diaphrams shall be piped to discharge at the exterior of buildings.

## 3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

## 3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

## 3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

## 3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements. New service and meter will be provided by Northshore Gas co.
Joseph Chinik is senior field coordinator at Northshore Gas co. located at 3001 Grand Avenue Waukegan Illinois 60085, contact information Office 847 263 4643 Fax 847 263 4620.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

## 3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

## 3.10 PAINTING

A. Comply with requirements in Division 9 painting Sections for painting interior and exterior natural-gas piping.

## 3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

**END OF SECTION 23 11 23**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**

**SECTION 23 21 13 - HYDRONIC PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Condensate-drain piping.
2. Emergency Generator Exhaust piping.

**1.2 DEFINITIONS**

A. PTFE: Polytetrafluoroethylene.

**1.3 SUBMITTALS**

A. Product data, including rated capacities of selected models, weights, and installation instructions.

B. Shop Drawings: Detail, at 1/2 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Brazer's certificates, signed by CONTRACTOR, certifying that brazers comply with requirements specified under the "Quality Assurance" Article below.

D. Welders' certificates certifying that welders comply with and meet the quality requirements specified herein. See Article entitled "Pipe Joint Construction."

E. If required by the OWNER, submit certification of compliance with ASTM and ANSI manufacturing requirements for pipe, fittings, and specialties.

F. Field quality-control test reports.

**1.4 QUALITY ASSURANCE**

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

## 1.5 DELIVERY, STORAGE AND HANDLING

**A. Refer to the Basic Mechanical Requirements for HVAC systems, Section 23 05 03.**

**B. For the purpose of protecting piping from pre-installation contamination, all piping shall be shipped to job site with suitable caps, sheet metal covers, or plugs. Pipe caps, etc., shall not be removed until just before installation.**

## 1.6 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION WORK.

# PART 2 – PRODUCTS

## 2.1 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type S, grade B, and minimum wall thickness of 0.375 inches.

B. Wrought-Steel welding Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

# PART 3 - EXECUTION

## 3.1 PIPING APPLICATIONS

A. Emergency generator exhaust piping shall be as follows:

1. Schedule 40 Type S seamless, ASTM A 53 black steel pipe; butt welding and socket welding.

B. Condensate-Drain Piping: Type M or DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

## 3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install drains, consisting of a tee fitting, NPS ¾ ball valve, and short NPS ¾ threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Identify piping as specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

## 3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Steel pipe stanchion saddle, MSS Type 37
2. Steel pipe saddle support, MSS Type 36

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch .

4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 12 feet ; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 12 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 12 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 12 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 12 feet.
13. NPS 16: Maximum span, 12 feet.
14. NPS 18: Maximum span, 12 feet.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

## 3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using silver based lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

**END OF SECTION 23 21 13**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**
**SECTION 23 31 13 - METAL DUCTS**

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Seam and joint construction.
8. Equipment installation based on equipment being used on Project.

9. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
10. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

1.4 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.5 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION.

**PART 2 - PRODUCTS**

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Aluminum Sheets: Comply with ANSI/ASTM B209 aluminum sheet, alloy 3003H-14.

C. Stainless-Steel Sheets: Comply with ASTM A 480, Type 304 stainless steel sheet No. 1 finish for concealed work and No. 4 for exposed work.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

2. Tape Width: 4 inches .
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg , positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F .
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg , positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

**PART 3 - EXECUTION**

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches .

J. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg : Seal Class A.
4. Unconditioned Space, Exhaust Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet .

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

A. All ductwork installed within the electrical control room shall be constructed of aluminum ductwork including hangers and supports.

B. All ductwork installed other than the electrical control room shall be constructed of stainless steel ductwork including hangers and supports.

C. Supply Ducts:

1. Ducts Connected to supply fans:

a. Pressure Class: Positive 2-inch wg.

b. Minimum SMACNA Seal Class: A.

D. Exhaust Ducts:

1. Ducts Connected to exhaust fans

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: A.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.

b. Not Exposed to Airstream: Match duct material.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm (5 m/s) or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch: Spin in.

**END OF SECTION 23 31 13**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**
**SECTION 23 33 00 - AIR DUCT ACCESSORIES**

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Control dampers.
2. Manual volume dampers.
3. Flexible connectors.
4. Duct-mounted access doors.
5. Duct accessory hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.

b. Manual volume damper installations.

c. Control-damper installations.

d. Wiring Diagrams: For power, signal, and control wiring.

C. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION.

**PART 2 - PRODUCTS**

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MANUAL VOLUME DAMPERS

A. Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA Standards. Dampers greater than 10-in height shall be multiblade type.

B. 16-gage galvanized steel frame and damper blade with 20-gage blade stop. Dampers installed in aluminum or stainless steel duct systems shall be constructed of 304 stainless steel.

C. All dampers shall be furnished with locking hand quadrant.

D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ruskin.
2. Greenheck.
3. Nailor Industries Inc.

2.3 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Metal Form Manufacturing, Inc.
6. Nailor Industries Inc.
7. Pottorff.
8. Ruskin Company.
9. Vent Products Company, Inc.

B. Frames:

1. Hat U Angle shaped.
2. 0.094-inch thick, aluminum 0.05-inch thick stainless steel.

C. Insulated Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Parallel- and opposed-blade design.
3. Aluminum and Stainless steel.
4. 0.064 inch- thick single skin or 0.0747-inch- thick dual skin.
5. Blade Edging: Closed-cell neoprene or PVC.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- diameter; aluminum or stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Actuators: Actuators and assembly located in the wet well and dry well shall be suitable for Class 1, Group D, Division 2 Hazardous locations explosion proof (NEMA 7) enclosure. Unless otherwise indicated, NEMA 2 enclosure.

2.4 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. .
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.5 DUCT ACCESS DOORS

A. Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Access doors shall be constructed of same material as the duct system served.

B. Provide flush frames for uninsulated ductwork, extended frame for externally insulated duct.

C. Provide one side hinged, other side with 1 handle-type latch for doors 12” high and smaller, 2 handle-type latches for larger doors.

D. Provide access doors on exhaust systems upstream of all elbows with turning vanes and upstream of electric heating coils.

E. Manufacturers : Subject to compliance with requirements provide duct access doors of one of the following:

1. Ruskin Mfg. Co.
2. Ventfabrics, Inc.
3. Nailor Industries Inc.

2.6 DUCT HARDWARE

A. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12”. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturers : Subject to compliance with requirements provide duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.
3. Nailor Industries Inc.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use stainless-steel accessories in stainless-steel ducts and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply and exhaust systems where branches extend from larger ducts.

1. Install aluminum volume dampers in aluminum ducts.
2. Install stainless steel volume dampers in stainless steel ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install flexible connectors to connect ducts to equipment.

G. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect turning vanes for proper and secure installation.

**END OF SECTION 23 33 00**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**
**SECTION 23 34 23 - HVAC POWER VENTILATORS**

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. In-line centrifugal fans.
2. Propeller fans.
3. Centrifugal wall ventilators.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Refer to class 1/ Div. 2 explosion proof construction where scheduled.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

**1.5 BASIS OF PAYMENT**

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION.

## PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing Corporation.
2. Carnes Company.
3. Greenheck Fan Corporation.
4. JencoFan.
5. Twin City Fan Companies Ltd.
6. PennBarry.

B. Housing: spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to side wall mounting.

C. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing. Belt and motor cover shall be constructed of aluminum. Drives shall be sized for a minimum of 150% of installed motor horsepower.

D. Fan Wheels: Aluminum, non-overloading centrifugal backward inclined type.

E. Accessories:
1. Companion Flanges: For inlet and outlet duct connections.
2. Fan Guards: Inlet safety guard.
3. Motor and Drive Cover (Belt Guard).
4. Explosion proof NEMA 7/9 disconnect.
5. Explosion proof motor.
6. Flex duct connections.
7. ACMA Type B spark resistant construction.
8. Vibration Isolators kit for vertical hanging installation.

2.2 PROPELLER FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing Corporation.
2. Carnes Company.
3. Greenheck Fan Corporation
4. Twin City Fan Companies Ltd.
5. PennBarry.

B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly. Factory applied prime ad finish coatings in manufacturer's standard corrosion resistant paint. Drive support shall be heavy gauge steel construction.

C. Fan Wheel: Replaceable, cast or extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

D. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing. Drives shall be sized for a minimum of 150% of installed motor horsepower.

E. Shaft and Drive:

1. Resiliently mounted to housing.
2. Statically and dynamically balanced.
3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
4. Extend grease fitting to accessible location outside of unit.
5. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
6. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

F. Accessories:
1. Filtered Wall Housing: Provide manufacturer's standard filtered wall housing for scheduled fan size. Housing shall be constructed of steel pre-punched mounting holes and finished with corrosion resistant paint. Provide with 2-in washable filter elements. Provide housing with motor side guard of welded steel wire construction
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

## 2.3 CENTRIFUGAL WALL VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing Corporation.
2. Carnes Company.
3. Greenheck Fan Corporation.
4. Twin City Fan Companies Ltd.
5. PennBarry.

B. Construction: Fan and motor housing shall be constructed of aluminum, fan hood shall be beaded or internally supported for rigidity. Fans shall be provided with pre-punched square mounting plate for mounting to wall. Up-blast type fans shall be provided with drain for the wind band. Drive assembly shall be isolated from fan plat to reduce vibration and noise transmission. Fans shall be of spark resistant construction and shall be constructed of non-ferrous materials in accordance with AMCA Tpe B Spark Resistant Construction.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Shaft and Drive:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and stainless steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Drives shall be sized for a minimum of 150% of installed motor horsepower.

E. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.

3. Explosion proof NEMA 7/9 disconnect.
4. Birdscreen: Provide manufacture's standard aluminum birdscreen.

2.4 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

2.5 Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.

7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

**END OF SECTION 23 34 23**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**
**SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES**

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Registers and grilles.

B. Related Sections:

1. Section 089000 “Louvers and Vents”.
2. Section 233300 "Air Duct Accessories" for volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Refer to Division 1 General Requirements for submittal requirements.

1.3 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION.

## PART 2 - PRODUCTS

2.1 REGISTERS AND GRILLES

A. Adjustable Louvered Face:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. A-J Manufacturing Co., Inc.
   b. Anemostat Products; a Mestek company.
   c. Carnes.
   d. Krueger.
   e. Nailor Industries Inc.
   f. Price Industries.
   g. Titus.
   h. Tuttle & Bailey.

2. Material: Stainless steel.
3. Finish: Satin Polish.
4. Face Blade Arrangement: Horizontal spaced.
5. Adjustable blade for supply.
6. Fixed blade for return.
7. Damper Type: Stainless steel adjustable opposed blade.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Install registers, and grilles level and plumb.

B. Install registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

C. Install stainless steel registers and grilles with stainless steel fasteners. Provide compounds that prevent galling of the stainless steel fastener.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION**

**DIVISION 23 – HEATING AND VENTILATION AND AIR CONDITIONING**
**SECTION 23 82 39.16 - PROPELLER UNIT HEATERS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes :

1. Explosion-proof electric unit heaters.
2. Propeller unit heaters with electric-resistance heating coils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

C. Refer to Division 1 General Requirements for submittal requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

1.5 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, HEATING AND VENTILATION.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Airtherm; a Mestek company.
2. Berko.
3. McQuay International.
4. Modine.
5. Ouellet.

2.2 DESCRIPTION

A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Refer to class 1/ Division 2 explosion proof construction where scheduled.

C. Comply with UL 2021.

D. Comply with UL 823.

E. Heater shall be suitable for Class I, Group D, Division 2 hazardous locations as indicated on mechanical schedules.

2.3 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 EXPLOSION-PROOF ELECTRIC UNIT HEATERS

A. Type: Propeller type, spark resistant, explosion-proof electric unit heater, suitable for a Class 1, Division 2, Group D Hazardous environment.

B. Construction: Unit casing shall be constructed epoxy coated heavy gauge steel enclosed in a heat transfer fluid.

C. Heating element shall be designed to ensure surface temperature does not exceed 320 degrees F.

D. Fans: Fans shall have permanently lubricated explosion-proof motor with built-in overloads.

E. Controls: Provide the following control devices prewired to units:

1. Magnetic contactor.
2. Automatic overtemperature cutout.
3. Transformer for 24-Volt control circuit.
4. Wall mounted explosion-proof thermostat meeting applicable requirements of this section.

2.5 PROPELLER ELECTRIC UNIT HEATER

A. Type: Propeller type electric unit heaters.

B. Construction: Unit casing shall be constructed heavy gauge steel. Provide with louvered air outlet and air inlet grille to act as fan guard.

C. Heating Element: Element shall be aluminum-finned, copper clad steel sheath construction. Provide units of voltage and capacities as scheduled.

D. Fans: Fan shall be aluminum construction and dynamically balanced.

E. Controls: Provide the following control devices prewired to units:

1. Power contactor.
2. Fan Delay Relay: Provide fan delay relay to keep unit fan running until all heat is dissipated from the heating elements.
3. Automatic overtemperature cutout.
4. Transformer 24-Volt control circuit.
5. Wall mounted thermostat meeting applicable requirements of this section.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install propeller unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods.

D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust initial temperature set points.

**END OF SECTION 23 82 39.16**

**DIVISION 26 – ELECTRICAL**

**SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Copper building wire rated 600 V or less.
   2. Fire-alarm wire and cable.
   3. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:
   1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.
   2. Section 271313 "Communications Copper Backbone Cabling" for twisted pair cabling used for data circuits.
   3. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer's authorized service representative.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, soft drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated at 600 V.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. American Bare Conductor.
   2. Okonite Company (The).
   3. Southwire Company.

C. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. RoHS compliant.
   3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
E. Conductor Insulation:
   1. Type THWN (90°C): Comply with UL 83.
   2. Type XHHW-2: Comply with UL 44.

## 2.2 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Allied Wire & Cable Inc.
   2. Radix Wire.
   3. Rockbestos-Suprenant Cable Corp.
B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
C. Signaling Line Circuits: Twisted, shielded pair, No. 18 AWG.
   1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 90 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
   1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.

## 2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Hubbell Power Systems, Inc.
   2. Service Wire Co.
   3. Thomas & Betts Corporation; A Member of the ABB Group.
C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
   1. Material: Copper.
   2. Type: Two hole with standard barrels.
   3. Termination: Compression.

## 2.4 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders, service conductors, motor feeders and starter feeders: Single conductor type XHHW-2, copper; stranded, no smaller than No. 12 AWG.
B. Branch Circuits: Copper. Single conductor type THWN Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Minimum size for branch circuits: no smaller than #12 AWG.
C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.
D. Control Circuits: single conductor type THWN, no smaller than No 14 AWG. Shielded instrumentation wiring shall use PVC insulated, tinned copper stranded, #16 AWG, twisted pair or triplet with aluminum mylar shielded and stranded #18 AWG copper drain wire, and overall black flame retardant PVC (90℃) 600 Volt jacket.
E. All wire and cable shall be routed from point to point in conduit; power, control and instrumentation shall not be combined in the same conduit. Wiring for the various systems shall be installed in separate raceways with each circuit being installed in a separate conduit; multiple control circuits can be routed in a shared conduit, and multiple instrumentation circuits can be routed in a shared conduit. Wiring shall not be spliced.

# PART 3 - EXECUTION

## 3.1 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

## 3.2 INSTALLATION OF FIRE-ALARM WIRING

A. Comply with NECA 1 and NFPA 72.
B. Wiring Method: Install wiring in metal pathway:
   1. Install plenum cable in environmental airspaces, including plenum ceilings.
   2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.
C. Wiring Method:
   1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
   2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.
   3. Signaling Line Circuits: Power-limited fire-alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
F. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
G. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

## 3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
D. Comply with requirements in Section 284621.11 “Addressable Fire-Alarm Systems” for connecting, terminating, and identifying wires and cables.

## 3.4 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

## 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

## 3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

## 3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
D. Perform tests and inspections with the assistance of a factory-authorized service representative.
    1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
    2. Perform each of the following visual and electrical tests:
        a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
        b. Test bolted connections for high resistance using one of the following:
            1) A low-resistance ohmmeter.
            2) Calibrated torque wrench.
            3) Thermographic survey.
        c. Inspect compression-applied connectors for correct cable match and indentation.
        d. Inspect for correct identification.
        e. Inspect cable jacket and condition.
        f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
        g. Continuity test on each conductor and cable.
        h. Uniform resistance of parallel conductors.
    3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
        a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
        b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
    4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
E. Cables will be considered defective if they do not pass tests and inspections.
F. Prepare test and inspection reports to record the following:
    1. Procedures used.
    2. Results that comply with requirements.
    3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

**END OF SECTION 26 05 19**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. National Electric Code Article 250.

1.2 SUMMARY
- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  1. Underground distribution grounding.
  2. Foundation steel electrodes.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  1. Test wells.
  2. Ground rods.
  3. Ground rings.
  4. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agencies field supervisor.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  1. Include the following:
     a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
        1) Test wells.
        2) Ground rods.
        3) Ground rings.
        4) Grounding arrangements and connections for separately derived systems.
     b. Instructions for periodic testing and inspection of grounding features at test wells ground rings grounding connections for separately derived systems based on NETA MTS.
        1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
        2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Certified by NETA.

1.7 BASIS OF PAYMENT
- A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Burndy; Part of Hubbell Electrical Systems.
   2. Siemens Industry, Inc., Energy Management Division.
   3. Thomas & Betts Corporation; Member of the ABB Group.

### 2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:
   1. Solid Conductors: ASTM B3.
   2. Stranded Conductors: ASTM B8.
   3. Tinned Conductors: ASTM B33.
   4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

### 2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
G. Conduit Hubs: Mechanical type, terminal with threaded hub.
H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
K. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
L. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
M. Straps: Solid copper, copper lugs. Rated for 400 A.
N. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

2.5 **GROUNDING ELECTRODES**

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.
B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

**PART 3 - EXECUTION**

3.1 **APPLICATIONS**

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 30 inches below grade.
C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
F. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.2 **GROUNDING AT THE SERVICE**

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

## 3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

## 3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

B. Comply with IEEE C2 grounding requirements.
C. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

## 3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.
B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

## 3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. Use exothermic welds for all below-grade connections.

3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
4. Ground rods are to be installed approximately every 25 feet.
5. At least one ground rod shall be installed in a vitrified clay pipe test well. Connections at the test well shall utilize compression type connectors on conductors with bolted and/or clamped type connections between the conductors and ground rod.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes shall be at least 12 inches deep, with cover.
1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.
1. The pump station design shall include at least 1 concrete encased grounding electrode to ground the building and structure footings to the ground grid.

J. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

K. Ground Triangle: Install at least one grounding triangle with ground rods spaced ten foot apart.
L. Signal and communication systems
   1. Shall be equipped with a minimum #4 AWG insulated green grounding conductor in raceway from grounding electrode system to each service location.

## 3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
B. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.
   4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
   5. The grounding system shall be specified to verify ground continuity and resistance at each ground rod location, at the service disconnect(s) and at each ground test well.
C. Grounding system will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.
E. Report measured ground resistances that exceed the following values:
   1. The pump station ground system shall be designed to achieve low ground grid resistance of 5 ohms or less.
F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION 26 05 26**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Conduit and cable support devices.
  2. Support for conductors in vertical conduit.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
     a. Slotted support systems, hardware, and accessories.
     b. Clamps.
     c. Hangers.
     d. Sockets.
     e. Eye nuts.
     f. Fasteners.
     g. Anchors.
     h. Saddles.
     i. Brackets.
  2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
  1. Hangers. Include product data for components.
  2. Equipment supports.
  3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Suspended ceiling components.
  2. Ductwork, piping, fittings, and supports.
  3. Structural members to which hangers and supports will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Items penetrating finished ceiling, including the following:
     a. Luminaires.
- B. Welding certificates.

1.5 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M.

1.6 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame Rating: Class 1.
   2. Self-extinguishing according to ASTM D635.

### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. B-line, an Eaton business.
      b. Thomas & Betts Corporation; A Member of the ABB Group.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   3. Material for Channel, Fittings, and Accessories: Stainless steel, Type 304.
   4. Channel Width: Selected for applicable load criteria.
   5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c., in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. B-line, an Eaton business.
      b. Haydon Corporation.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   3. Channel Width: Selected for applicable load criteria.
   4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
   5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
   6. Rated Strength: Selected to suit applicable load criteria.

7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Hilti, Inc.
      2) MKT Fastening, LLC.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) B-line, an Eaton business.
      2) Hilti, Inc.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Toggle Bolts: Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

## PART 3 - EXECUTION

### 3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
    1. Secure raceways and cables to these supports with two-bolt conduit clamps.
F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

## 3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
B. Raceway Support Methods: In addition to methods described in NECA 1,RMC may be supported by openings through structure members, according to NFPA 70.
C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
    1. To Wood: Fasten with lag screws or through bolts.
    2. To New Concrete: Bolt to concrete inserts.
    3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
    4. To Existing Concrete: Expansion anchor fasteners.
    5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
    6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
    7. To Light Steel: Sheet metal screws.
    8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

## 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
B. Field Welding: Comply with AWS D1.1/D1.1M.

## 3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
B. Use 4000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
C. Anchor equipment to concrete base as follows:
    1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    2. Install anchor bolts to elevations required for proper attachment to supported equipment.
    3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

## 3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
    1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.Retain "Touchup" Paragraph below if a painting Section is in Project Manual.
B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

**END OF SECTION 26 05 29**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Metal conduits and tubing.
  2. Metal wireways and auxiliary gutters.
  3. Boxes, enclosures, and cabinets.
  4. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS
- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS
- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  1. Structural members in paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

1.6 BASIS OF PAYMENT
- A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND TUBING

- A. Galvanized Rigid Steel Conduit: ANSI C80.1.
- B. Flexible Metal Conduit: Zinc-coated steel.
- C. Liquidtight Flexible Conduit: Flexible steel conduit with PVC jacket.
- D. Plastic-Coated Steel Conduit and Fittings: UL Listed (UL-6); rigid steel conduit system as specified with coated interior walls and external PVC coating, 40 mil (.1 mm) thick. The PVC coating must have been investigated by UL as providing the primary corrosion protection for the rigid steel conduit. Ferrous fittings for general service location shall be UL listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating shall be UL listed.
  1. The PVC coating shall have the following characteristics:

| | |
|---|---|
| Hardness | 85+ Shore A Durometer |
| Dielectric Strength | 400 V/mil @ 60 Hz |
| Aging | 1000 Hours Atlas Weathermeter |

| | |
|---|---|
| Temperature | The PVC compound shall conform at O deg F to Federal Specifications PL-406b, Method 2051, amendment 1 of 25 September 1952 (ASTM D 746) |
| Elongation | 200% |

2. The exterior and interior galvanized conduit surface shall be chemically treated to enhance PVC coating adhesion and shall also be coated with a primer before the PVC coating to ensure a bond between the zinc substrate and the PVC coating. The bond strength created shall be greater than the tensile strength of the plastic coating.
3. The PVC exterior and urethane interior coating applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above -1 deg C (30 deg F).
4. An interior urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. The interior coating shall be applied in a manner so there are no peel, flake, or chip off after a cut is made in the conduit or a scratch is made in the coating.
5. Conduit bodies shall have a tongue-in-groove gasket for maximum scaling capability. The design shall incorporate a positive placement feature to assure proper installation. Certified test results confirming seal performance at 15 psig (positive) and 25 in of mercury (vacuum) for 72 hours shall be submitted for review when requested by the Engineer.
6. The PVC conduit shall pass the following tests:
   a. Exterior PVC bond test RN1:
      Two parallel cuts 13 mm (1/2 inch) apart and 40 mm (1 ½ inches) in length shall be made with a sharp knife along the longitudinal axis. A third cut shall be made perpendicular to and crossing the longitudinal cuts at one end. The knife shall then be worked under the PVC coating for 13 mm (1/2 inch) to free the coating from the metal.
      Using pliers, the freed PVC tab shall be pulled with a force applied vertically and away from the conduit. The PVC tab shall tear rather than cause any additional PVC coating to separate from the substrate.

   b. Boil Test
      Acceptable conduit coating bonds (exterior and interior) shall be confirmed if there is no disbondment after a minimum average of 200 hours in boiling water or exposure to steam vapor at one atmosphere. Certified test results from a national independent testing laboratory shall be submitted for review and approval. The RN1 Bond Test and the Standard Method for Measuring Adhesion by Tape Test shall be utilized.
      Exterior Adhesion. In accordance with ASTM D870, a 6” length of conduit test specimen shall be placed in boiling water. The specimen shall be periodically removed, cooled to ambient temperature and immediately tested according to the bond test (RN1).

   c. Heat Humidity Test
      Acceptable conduit coating bonds shall be confirmed by a minimum average of 30 days in the Heat and Humidity Test. The RN1 Bond Test and the Standard Method for Measuring Adhesion by Tape Test shall be utilized.

Exterior Adhesion. In accordance with ASTM D1151, D1735, D2247 and D4585, conduit specimen shall be placed in a heat and humidity environment where the temperature is maintained at 150 deg F (66 deg C) and 95 % relative humidity. The specimen shall be periodically removed and a bond test (RN1) performed. When the PVC coating separates from the substrate, the exposure time to failure in days shall be recorded.
Interior Adhesion: In accordance with ASTM D3359, conduit specimen shall be placed in heat and humidity environment where the temperature is maintained at 150 deg F (66 deg C) and 95% relative humidity. When the coating disbands, the time to failure in hours shall be recorded.

7. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Southwire Company.
   b. Thomas & Betts Corporation; a Member of the ABB Group.
   c. Western Tube and Conduit Corporation.
8. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
9. GRC: Comply with ANSI C80.1 and UL 6.
   a. GRC shall be hot dipped
10. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
    a. Comply with NEMA RN 1.
    b. Coating Thickness: 0.040 inch, minimum.
11. EMT: Comply with ANSI C80.3 and UL 797.
12. FMC: Comply with UL 1; zinc-coated steel.
13. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

E. Metal Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Southwire Company.
   b. Thomas & Betts Corporation; a Member of the ABB Group.
   c. Western Tube and Conduit Corporation.
2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:
   a. Material: Steel.
   b. Type: compression.
7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

F. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:
   1. Rigid Nonmetallic Polyvinyl Chloride (PVCP Conduit. NEMA TC 2, Schedule 40 or 80 PVC.
   2. PVC Conduit Fittings: NEMA TC 3; match to conduit type and material.
   3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Electri-Flex Company.
      b. RACO; Hubbell.
      c. Thomas & Betts Corporation; a Member of the ABB Group.
   4. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   5. Fiberglass:
      a. Comply with NEMA TC 14.
      b. Comply with UL 2515 for aboveground raceways.
      c. Comply with UL 2420 for belowground raceways.
   6. ENT: Comply with NEMA TC 13 and UL 1653.
   7. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
   8. LFNC: Comply with UL 1660.
   9. Rigid HDPE: Comply with UL 651A.
   10. Continuous HDPE: Comply with UL 651A.
   11. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
   12. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Electri-Flex Company.
      b. RACO; Hubbell.
      c. Thomas & Betts Corporation; a Member of the ABB Group.
      d. Topaz Electric; a division of Topaz Lighting Corp.
   2. Fittings, General: Listed and labeled for type of conduit, location, and use.
   3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
      a. Fittings for LFNC: Comply with UL 514B.
   4. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Hoffman; a brand of nVent.
   2. Hubbell Incorporated; Wiring Device-Kellems.
   3. RACO; Hubbell.
   4. Thomas & Betts Corporation; a Member of the ABB Group.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lbs. shall be listed and marked for the maximum allowable weight.
G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
K. Gangable boxes are prohibited.
L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.
    1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
    2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
M. Cabinets:
    1. NEMA 250, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
    2. Hinged door in front cover with flush latch and concealed hinge.
    3. Key latch to match panelboards.
    4. Metal barriers to separate wiring of different systems and voltage.
    5. Accessory feet where required for freestanding equipment.
    6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
    1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
    2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
        a. Armorcast Products Company.
        b. Oldcastle Enclosure Solutions.
        c. Oldcastle Precast, Inc.
        d. Quazite: Hubbell Power Systems, Inc.
    2. Standard: Comply with SCTE 77.
    3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.5 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Tests of materials shall be performed by an independent testing agency.
   2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

# PART 3 - EXECUTION

## 3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC.
   2. Concealed Conduit, Aboveground: GRC.
   3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

B. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
C. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC.
   2. Concealed Conduit, Aboveground: GRC.
   3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
D. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: RNC.
   2. Exposed, Not Subject to Severe Physical Damage: RNC identified for such use.
   3. Exposed and Subject to Severe Physical Damage: GRC.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   5. Damp or Wet Locations: GRC.
   6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
E. Minimum Raceway Size: 3/4-inch trade size.

F. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
   4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

G. Install surface raceways only where indicated on Drawings.

## 3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
D. Do not fasten conduits onto the bottom side of a metal deck roof.
E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
F. Complete raceway installation before starting conductor installation.
G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
J. Install conduits parallel or perpendicular to building lines.
K. Support conduit within 12 inches of enclosures to which attached.
L. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
   5. Change from ENT to GRC before rising above floor.
M. Stub-Ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
V. Surface Raceways:
    1. Install surface raceway with a minimum 2-inch radius control at bend points.
    2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
    1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    2. Where an underground service raceway enters a building or structure.
    3. Conduit extending from interior to exterior of building.
    4. Conduit extending into pressurized duct and equipment.
    5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    6. Where otherwise required by NFPA 70.
Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
Z. Expansion-Joint Fittings:
    1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

EE. Locate boxes so that cover or plate will not span different building finishes.

FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

HH. Set metal floor boxes level and flush with finished floor surface.

II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

JJ. Wetwell and Drywell are hazardous locations – raceway explosion proof sealing fittings shall be included where conduits enter or leave a hazardous rated area.

## 3.3 INSTALLATION OF UNDERGROUND CONDUIT

KK. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in drawings"
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

## 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
D. Install handholes with bottom below frost line, 42” below grade.
E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

## 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

## 3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

## 3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 26 05 33**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
  2. Sleeve-seal systems.
  3. Sleeve-seal fittings.
  4. Grout.
  5. Silicone sealants.
- B. Related Requirements:
  1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.

1.4 BASIS OF PAYMENT
- A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 SLEEVES

- A. Wall Sleeves:
  1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
  1. Material: Galvanized sheet steel.
  2. Minimum Metal Thickness:
     a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
     b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CALPICO, Inc.
      b. Pipeline Seal and Insulator, Inc.
      c. Proco Products, Inc.
      d. RoxTec.
   2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Carbon steel.
   4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. RoxTec.
      b. HOLDRITE.

# PART 3 - EXECUTION

## 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.
B. Comply with NEMA VE 2 for cable tray and cable penetrations.
C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

## 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

## 3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
C. Secure nailing flanges to concrete forms.
D. Using grout, seal the space around outside of sleeve-seal fittings.

**END OF SECTION 26 05 44**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  2. Labels.
  3. Bands and tubes.
  4. Tapes and stencils.
  5. Tags.
  6. Signs.
  7. Cable ties.
  8. Paint for identification.
  9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

1.4 BASIS OF PAYMENT
- A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

1.5 PERFORMANCE REQUIREMENTS
- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145 for arc-flash labels.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.6 COLOR AND LEGEND REQUIREMENTS
- A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service and branch-circuit conductors.
1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:
a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
3. Colors for 240-V Circuits:
a. Phase A: Black.
b. Phase B: Red.
4. Colors for 480/277-V Circuits:
a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
5. Color for Neutral: White.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Warning Label Colors:
1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

E. Equipment Identification Labels:
1. Black letters on a white field.

1.7 LABELS

A. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.
b. Marking Services, Inc.
c. Panduit Corp.
2. Minimum Nominal Size:
a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

1.8 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.

b. Marking Services, Inc.
c. Seton Identification Products.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.
b. Marking Services, Inc.
c. Panduit Corp.

1.9 SIGNS

A. Baked-Enamel Signs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Carlton Industries, LP.
b. Marking Services, Inc.
2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.
b. Marking Services, Inc.
2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Brady Corporation.
b. Marking Services, Inc.
2. Engraved legend.
3. Thickness:
a. For signs up to 20 sq. in., minimum 1/16 inch thick.
b. For signs larger than 20 sq. in., 1/8 inch thick.
c. Engraved legend with white letters on a dark gray background.
d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

1.10 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Marking Services, Inc.
   2. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.
   4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.
   4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.

1.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

**PART 3 - EXECUTION**

1.12 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

1.13 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.
H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
   3. "UPS."
L. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
M. Self-Adhesive Labels:
   1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
N. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
P. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
Q. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
T. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade.
   2. Install underground-line warning tape for direct-buried cables and cables in raceways.
U. Metal Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using general-purpose cable ties.
V. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

W. Baked-Enamel Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

X. Metal-Backed Butyrate Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

Y. Laminated Acrylic or Melamine Plastic Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

Z. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

1.14 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

G. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

I. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

J. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
   1. Apply to exterior of door, cover, or other access.
   2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
      a. Power-transfer switches.
      b. Controls with external control power connections.

M. Arc Flash Warning Labeling: Self-adhesive labels.

N. Operating Instruction Signs: Baked-enamel warning signs.

O. Emergency Operating Instruction Signs: Baked-enamel warning signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

P. Equipment Identification Labels:
   1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
   2. Outdoor Equipment: Laminated acrylic or melamine sign.
   3. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of an engraved, laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Access doors and panels for concealed electrical items.
      d. Switchgear.
      e. Switchboards.
      f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
      g. Emergency system boxes and enclosures.
      h. Motor-control centers.
      i. Enclosed switches.
      j. Enclosed circuit breakers.
      k. Enclosed controllers.
      l. Push-button stations.
      m. Power-transfer equipment.
      n. Contactors.
      o. Power-generating units.
      p. Monitoring and control equipment.

q. UPS equipment.

**END OF SECTION 26 05 53**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 05 73.13 - SHORT-CIRCUIT STUDIES**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS
- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS
- A. Product Data:
  1. For computer software program to be used for studies.
  2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
     a. Short-circuit study input data, including completed computer program input data sheets.
     b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
        1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
        2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
2. The following are from the Short-Circuit Study Report:
a. Final one-line diagram.
b. Final Short-Circuit Study Report.
c. Short-circuit study data files.
d. Power system data.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.
1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

D. Power Systems Qualified Company: The Company hired to perform this study shall have a minimum of 10 years of documented experience in the field of Power System Studies and be licensed to perform Professional Engineering in the State of Illinois.

E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state of Illinois. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

F. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist who is a licensed professional engineer in Illinois.

G. Field Adjusting Agency Qualifications:
1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

1.8 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ETAP.
2. Power Analytics, Corporation.

3. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.
   1. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

## 2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:
   1. Protective device designations and ampere ratings.
   2. Conductor types, sizes, and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
   6. Derating factors and environmental conditions.
   7. Any revisions to electrical equipment required by the study.

D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.

E. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
   2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
   3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
   4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
   5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:
   1. One-line diagram of system being studied.
   2. Power sources available.
   3. Manufacturer, model, and interrupting rating of protective devices.
   4. Conductors.
   5. Transformer data.

G. Short-Circuit Study Output Reports:
   1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated fault-current magnitude and angle.
      c. Fault-point X/R ratio.

d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:
      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

## PART 3 - EXECUTION

### 3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.
   1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer’s attention.
   2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
   1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at the service.
   3. Power sources and ties.
   4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.

6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
11. Derating factors.

## 3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.
B. Calculate short-circuit currents according to IEEE 551.
C. Base study on device characteristics supplied by device manufacturer.
D. Begin short-circuit current analysis at the service, extending down to system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.
E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
F. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
H. Include in the report identification of any protective device applied outside its capacity.

**END OF SECTION 26 05 73.13**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 05 73.16 - COORDINATION STUDIES**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
  1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS
- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS
- A. Product Data:
  1. For computer software program to be used for studies.
  2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
     a. Coordination-study input data, including completed computer program input data sheets.
     b. Study and equipment evaluation reports.
  3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
     a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data:
  1. For Power System Analysis Software Developer.
  2. For Power Systems Analysis Specialist.
  3. For Field Adjusting Agency.
- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
  1. The following are from the Coordination Study Report:
     a. Final one-line diagram.
     b. Final protective device coordination study.
     c. Coordination study data files.
     d. List of all protective device settings.
     e. Time-current coordination curves.
     f. Power system data.

1.7 QUALITY ASSURANCE
- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
  1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
  2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Qualified Company: The Company hired to perform this study shall have a minimum of 10 years of documented experience in the field of Power System Studies and be licensed to perform Professional Engineering in the State of Illinois.
- F. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the State of Illinois. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- G. Field Adjusting Agency Qualifications:
  1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
  2. A member company of NETA.
  3. Acceptable to authorities having jurisdiction.

1.8 BASIS OF PAYMENT
- A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ETAP.

2. Power Analytics, Corporation.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
   1. Optional Features:
      a. Arcing faults.
      b. Simultaneous faults.
      c. Explicit negative sequence.
      d. Mutual coupling in zero sequence.

## 2.2 COORDINATION STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:
   1. Protective device designations and ampere ratings.
   2. Conductor types, sizes, and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations.
   6. Any revisions to electrical equipment required by the study.
   7. Study Input Data: As described in "Power System Data" Article.
      a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

D. Protective Device Coordination Study:
   1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
      a. Phase and Ground Relays:
         1) Device tag.
         2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
         3) Recommendations on improved relaying systems, if applicable.
      b. Circuit Breakers:
         1) Adjustable pickups and time delays (long time, short time, and ground).
         2) Adjustable time-current characteristic.
         3) Adjustable instantaneous pickup.
         4) Recommendations on improved trip systems, if applicable.
      c. Fuses: Show current rating, voltage, and class.

E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream

devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:
    a. Power utility's overcurrent protective device.
    b. Medium-voltage equipment overcurrent relays.
    c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    f. Cables and conductors damage curves.
    g. Ground-fault protective devices.
    h. Motor-starting characteristics and motor damage points.
    i. Generator short-circuit decrement curve and generator damage point.
    j. The largest feeder circuit breaker in each motor-control center and panelboard.
5. Maintain selectivity for tripping currents caused by overloads.
6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
7. Provide adequate time margins between device characteristics such that selective operation is achieved.
8. Comments and recommendations for system improvements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
    1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

### 3.2 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the overcurrent protective device study.
    1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
    2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and

control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment

range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.

k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

## 3.3 COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:
   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.

K. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

M. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to short-circuit ratings.
   2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
   3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
   4. Include in the report identification of any protective device applied outside its capacity.

## 3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
   1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
   2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.
   3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

## 3.5 MOTOR-STARTING STUDY

A. Perform a motor-starting study to analyze the transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of motor starting on the power system stability.

## 3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

## 3.7 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

**END OF SECTION 26 05 73.16**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 05 73.19 - ARC-FLASH HAZARD ANALYSIS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS
- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS
- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
  1. Arc-flash study input data, including completed computer program input data sheets.
  2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
  3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data:
  1. For Power Systems Analysis Software Developer.

2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
2. Operation and Maintenance Procedures: provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

E. Power Systems Qualified Company: The Company hired to perform this study shall have a minimum of 10 years of documented experience in the field of Power System Studies and be a licensed to perform Professional Engineering in the State of Illinois.

F. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, licensed in the state of Illinois. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

G. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist who is a licensed professional engineer in Illinois.

H. Field Adjusting Agency Qualifications:
1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

1.8 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ETAP.

2. Power Analytics, Corporation.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.
C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

## 2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.
B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Conductor types, sizes, and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
D. Study Input Data: As described in "Power System Data" Article.
E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
G. Arc-Flash Study Output Reports:
   1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
H. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   4. Arc-flash boundary.
   5. Restricted approach boundary.
   6. Limited approach boundary.
   7. Working distance.
   8. Incident energy.
   9. Hazard risk category.
   10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

## 2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
    1. Location designation.
    2. Nominal voltage.
    3. Protection boundaries.
        a. Arc-flash boundary.
        b. Restricted approach boundary.
        c. Limited approach boundary.
    4. Arc flash PPE category.
    5. Required minimum arc rating of PPE in Cal/cm squared.
    6. Available incident energy.
    7. Working distance.
    8. Engineering report number, revision number, and issue date.
C. Labels shall be machine printed, with no field-applied markings.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

## 3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.
B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.
    1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
    2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
C. Calculate maximum and minimum contributions of fault-current size.
    1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
    2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
    3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.

4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.

D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.

F. Calculate the limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
   1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
   2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
   1. When the circuit breaker is in a separate enclosure.
   2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

## 3.3 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
   1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
   2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
   3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance or available short circuit current at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

## 3.4 LABELING

A. Apply one arc-flash label on the front cover of each section of the equipment for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
B. Each piece of equipment listed below shall have an arc-flash label applied to it:
   1. Motor-control center.
   2. Low-voltage switchboard.
   3. Switchgear.
   4. Medium-voltage switch.
   5. Medium voltage transformers
   6. Low voltage transformers.
   7. Panelboard and safety switch over 250 V.
   8. Applicable panelboard and safety switch under 250 V.
   9. Control panel.
C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
   1. Indicate arc-flash energy.
   2. Indicate protection level required.

## 3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

## 3.6 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

**END OF SECTION 26 05 73.19**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 09 13 - ELECTRICAL POWER MONITORING AND CONTROL**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes equipment and systems used to monitor and control electrical consumption:
  1. Power meters.
  2. Raceways and boxes.
  3. Wires and cables.
  4. Identification.

1.3 DEFINITIONS
- A. Active Power: The average power consumed by a unit. Also known as "real power."
- B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
- C. Apparent (Phasor) Power: "S = VI" where "S" is the apparent power, "V" is the rms value of the voltage, and "I" is the rms value of the current.
- D. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.
- E. KY Pulse: A method of measuring consumption of electricity that is based on a relay operating like a SPST switch.
- F. KYZ Pulse: A method of measuring consumption of electricity based on a relay operating like a SPDT switch.
- G. LAN: Local area network.
- H. L-G: Line to ground.
- I. L-L: Line to line.
- J. L-N: Line to neutral.
- K. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.
- L. Modbus TCP/IP: An open protocol for exchange of process data.
- M. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- N. N-G: Neutral to ground.
- O. Power Factor: The ratio of active power to apparent power, sometimes expressed in percentage.
- P. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.
- Q. TCP/IP: Transport control protocol/Internet.
- R. UPS: Uninterruptible power supply; used both in singular and plural context.

1.4 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for power monitoring and control.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For power monitoring and control equipment.
1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, method of field assembly, components, and location and size of each field connection.
a. Attach copies of approved Product Data submittals for products (such as switchboards, switchgear, and motor-control centers) that describe the following:
1) Location of the meters and gateways, and routing of the connecting wiring.
2) Details of power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.
3. Surge Suppressors: Data for each device used and where applied.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.
B. Design Data:
1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.
a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format on compact disk or portable storage device with a USB interface.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses, and 24-hour telephone numbers of Installer and service representatives for the system and products.
e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to do the following:
1) Design and install new points, panels, and other hardware.
2) Perform preventive maintenance and calibration.
3) Debug hardware problems.
4) Repair or replace hardware.
h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on compact disk or portable storage device with a USB interface.
j. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
k. Complete original-issue copies of furnished software, including operating systems, custom programming language, workstation software, and

graphics software on compact disk or portable storage device with a USB interface.

l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

m. Owner training materials.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power monitoring and control units to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 COORDINATION

A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of specified functions.

B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.9 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control of electrical power distribution system(s) that includes the following:

1. Electrical meters that monitor, control, and connect to the data transmission network.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. UL Compliance: Listed and labeled as complying with UL 61010-1.

### 2.2 PERFORMANCE REQUIREMENTS

A. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

B. Backup Power Source:

1. Electrical power distribution equipment served by a backup power source for controls shall have associated power monitoring and control system products that monitor and control such systems and equipment also served from a backup power source.

### 2.3 POWER METERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company.
3. Schneider Electric USA, Inc.
4. Siemens Industry, Inc., Energy Management Division.

B. Description: Separately mounted, modular, permanently installed, solid-state, digital I/O instrument for power monitoring and control; complying with UL 61010-1.
   1. Capable of metering 4-wire Y, 3-wire Y, 3-wire delta, and single-phase power systems.
   2. Equipped with security lock to protect revenue related metering from unauthorized and accidental changes.

C. Environment: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   1. Comply with IEC 60529 degree of protection code of IP51 for the front of the meter, and code of IP30 for the body.

D. Overvoltage: Comply with UL 61010-1 overvoltage withstand rating for CAT III.

E. Accuracy:
   1. Comply with ANSI C12.20, Class 0.5.
   2. Neutral Current Measurement: Not more than 0.65 percent.
   3. Power: 0.6 percent.
   4. Power Factor: 0.5 percent.
   5. Active Energy: 0.6 percent.
   6. Reactive Energy: 2.5 percent.
   7. Frequency: 0.05 percent.
   8. THD: 1.0 percent.
   9. Waveform Sampling: 32 per cycle.

F. Data Link:
   1. RS-485 Modbus RTU protocol, 4-wire connection.
      a. Provide for firmware and software updates through the communications port.

G. Meter Physical Characteristics:
   1. Display: Backlit LCD with antiglare and scratch-resistant lens.
   2. Display of Metered Values: One screen to show at least four lines of user-selected values on one screen at the same time. Provide graphical representation of user-selected values. The screen selections available at the display shall include the following:
      a. All meters, including those listed under the following:
         1) Measurements.
         2) THD.
         3) Energy.
         4) Demand.
         5) Minimum and maximum values.
         6) Power demand.

H. Sampling Rate: Continuously sample and record voltage and current at a rate not less than 32 samples per cycle, simultaneously on all voltage and current channels of the meter.

I. Meters:
   1. Measurements: Instantaneous, in real time, rms to the 15th harmonic.
      a. Voltage: L-L each phase, L-N each phase, and three-phase average.
      b. Current: Each phase, three-phase average, and neutral.
      c. Unbalanced current, L-L V ac and L-N V ac.

d. Active Power (+/- kW): Each phase and three-phase total.
e. Reactive Power (+/- kVAR): Each phase and three-phase total.
f. Apparent Power (+/- kVA): Each phase and three-phase total.
g. Displacement Power Factor: Each phase and three-phase total.
h. Distortion Power Factor: Each phase and three-phase total.
i. Frequency.

2. THD from measurements simultaneously from the same cycle, through 15th harmonic.
   a. Voltage THD: L-L each phase, L-N each phase, and three-phase average.
   b. Current THD: Each phase and three-phase average.
   c. Total demand distortion.
3. Energy: Accumulated, indicate whether in-flow or out-flow, net and absolute values. Store the values in instrument's nonvolatile memory.
   a. Active kWh.
   b. Reactive kVARh.
   c. Apparent kVAh.
4. Demand: Present, last, predicted, peak.
   a. Three-phase average current.
   b. Three-phase total active power (kW).
   c. Reactive power (kVAR).
   d. Apparent power (kVA).
5. Minimum and Maximum Values:
   a. L-L and L-N voltages.
   b. Current in each phase.
   c. Power factor.
   d. Active power total.
   e. Reactive power total.
   f. Apparent power total.
   g. THD L-L and L-N voltages.
   h. THD current in each phase.
   i. Frequency.

J. Power Demand, User Selectable:
1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:
   a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
   b. Fixed block that calculates demand at end of the interval.
   c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.
3. Demand Calculation Initiated by a Synchronization Signal:
   a. Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
   b. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
   c. Provide for synchronizing the demand with the internal of this instrument.

K. Data Recording: Store the listed values in instrument's nonvolatile memory, indicate which of the three phases relates to the value. Attach a date and time stamp to the peak values and the alarms.
   1. Minimum and maximum of real-time rms measurement.
   2. Energy.
   3. Demand values.
   4. Alarms, store the last 40 events.

L. Alarms: Transmit a digital output and show on display when alarmed. Provide for no fewer than 15 metered items. Each alarm shall be user configured, by using the following options:
   1. Date and time stamp.
   2. Enable-disable (default) or enable.
   3. Pickup magnitude.
   4. Pickup time delay.
   5. Dropout magnitude.
   6. Dropout time delay.
   7. Alarm type.
   8. Alarm label.

M. Output Signals: Provide two mechanical relays, rated not less than 250-V ac, 2-A resistive, and rated for 200-k cycles or more. The relays shall be user configurable in one of the following listed modes:
   1. Normal contact closure where the contacts change state for as long as the signal exists.
   2. Latched mode when the contacts change state when a pickup signal is received and are held until a dropout signal is received.
   3. Timed mode when the contacts change state when a pickup signal is received and are held for a preprogrammed duration.

N. Meter Face:
   1. Display: Backlit LCD display, six lines, with antiglare and scratch-resistant lens.
   2. Display of Metered Values: One screen to show at least **four** user-selected values on one screen at the same time.
   3. Provide for the reset of metered peak values.

O. Capacities and Characteristics:
   1. Power Supply: 120-V ac, 60 Hz.
   2. Circuit Connections:
      a. Voltage: Measurements autoranging, 60- to 400-V ac L-N. Connect directly to low-voltage (600 V and less) without using voltage transformers. Meter impedance shall be 2-megohm L-L or greater. Overload Tolerance: 1500-V ac, rms, continuously.
      b. Current: Connect to instrument grade current transformer with a metering range of 5 mA to 6 A. Overcurrent tolerance of the instrument shall be 10 A continuous, 50 A for 10 seconds once per hour, and 120 A for one second per hour.
      c. Frequency: 45 to 65 Hz.
      d. Time: Input from a GPS receiver to synchronize the internal clock of the instrument and to time-synchronize this instrument with the network to a deviation of not greater than 1 ms.

## 2.4 RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.

## 2.5 WIRES AND CABLES

A. Electrical Power Wiring: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
   1. Copper conductors are Type THHN/THWN-2.

B. RS-232 Cable:
   1. PVC-Jacketed, RS-232 Cable: Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
      a. Type CM.
      b. Flame Resistance: UL 1581, vertical tray.
   2. Plenum-Type, RS-232 Cable: Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
      a. Type CMP.
      b. Flame Resistance: NFPA 262, flame test.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 POWER MONITORING AND CONTROL SYSTEM INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Wiring and Cabling Installation:
   1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.

E. Raceways Installation:
   1. Comply with Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.

F. Identification Installation:
   1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
   2. Comply with Section 271513 "Communications Copper Horizontal Cabling" for identification products and cable management system requirements for twisted pair cable, RS-485 cable, low-voltage control cable, and RS-232 cable.

## 3.3 WORKSTATION INSTALLATION

A. Desktop Workstations Installation:
   1. Install workstation(s) at location(s) directed by Owner.
   2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single, duplex electrical power receptacle.
   3. Install software on workstation(s) and verify that software functions properly.
   4. Develop Project-specific graphics, trends, reports, logs, and historical database.
   5. Power workstation through a UPS unit. Locate UPS adjacent to workstation.

B. Portable Workstations Installation:
   1. Turn over portable workstations to Owner at Substantial Completion.
   2. Install software on workstation(s) and verify that software functions properly.

C. Graphics Application:
   1. Use system schematics indicated as starting point to create graphics.
   2. Develop Project-specific library of symbols for representing system equipment and products.
   3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
   4. Seek Owner input in graphics development once using graphics software.
   5. Final editing shall be done on-site with Owner's review and feedback.
   6. Refine graphics as necessary for Owner acceptance.
   7. On receiving Owner acceptance, print a hard copy to include in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of the system operation and maintenance manual.

## 3.4 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

## 3.5 GROUNDING

A. For data communication wiring, comply with NECA/BICSI 568.
B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

## 3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engagea qualified testing agency to perform tests and inspections.
B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Visually inspect balanced twisted pair cabling and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test balanced twisted pair cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
5. Optical-Fiber Cable Tests:
    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:
        1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to IEC 61280-4-1.
        2) Attenuation test results for links shall be less than **2.0 dB**.
    c. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
6. Power Monitoring and Control System Tests.
    a. Test Analog Signals:
        1) Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
        2) Check analog current signals using a precision current meter at zero, 50, and 100 percent.
        3) Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.
    b. Test Digital Signals:
        1) Check digital signals using a jumper wire.
        2) Check digital signals using an ohmmeter to test for contact making or breaking.
    c. I/O Control Loop Tests:
        1) Test every I/O point to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
        2) Test every I/O point throughout its full operating range.
        3) Test every control loop to verify that operation is stable and accurate.

4) Adjust control loop proportional, integral, and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5) Test and adjust every control loop for proper operation according to sequence of operation.
6) Test software and hardware interlocks for proper operation.
7) Operate each analog point at the following:
   a) Upper quarter of range.
   b) Lower quarter of range.
   c) At midpoint of range.
8) Exercise each binary point.
9) For every I/O point in the system, read and record each value at workstation, at controller, and at field instrument simultaneously. Value displayed at workstation and at field instrument shall match.
10) Prepare and submit a report documenting results for each I/O point in the system, and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

D. Wiring and cabling will be considered defective if they do not pass tests and inspections.
E. Prepare test and inspection reports.

## 3.7 FINAL REVIEW

A. Submit written request to Architect **and Construction Manager** when the power monitoring and control system is ready for final review. Written request shall state the following:
   1. The system has been thoroughly inspected for compliance with Contract Documents and found to be in full compliance.
   2. The system has been calibrated, adjusted, and tested and found to comply with requirements of operational stability, accuracy, speed, and other performance requirements indicated.
   3. The system monitoring and control of electrical distribution systems results in operation according to sequences of operation indicated.
   4. The system is complete and ready for final review.
B. Review by **Architect and Construction Manager** will be made after receipt of written request. A field report shall be issued to document observations and deficiencies.
C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.
D. Final review shall include a demonstration to parties participating in final review.

## 3.8 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for tw] years.
B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within **two** years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least **30** days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

## 3.9 DEMONSTRATION

A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain the power monitoring and control system.

B. Extent of Training:
   1. Base extent of training on scope and complexity of power monitoring and control system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
   2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
   3. Minimum Training Requirements:
      a. Provide no fewer than **two** days of training total.
      b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
      c. Total days of training shall be broken into not more than **two** separate training classes.
      d. Each training class shall be no fewer than **two** consecutive day(s).

C. Attendee Training Manuals:
   1. Provide each attendee with a color hard copy of all training materials and visual presentations.
   2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
   3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

D. Instructor Requirements:
   1. One or multiple qualified instructors, as required, to provide training.
   2. Instructors shall have no fewer than **five** years of providing instructional training on no fewer than **five** past projects with similar electrical monitoring and control system scope and complexity.

E. Training Outline: Submit training outline for Owner review at least **10** business days before scheduling training. Outline shall include a detailed agenda for each training day that is broken down into each training session that day, training objectives for each training session, and synopses for each lesson planned.

F. On-Site Training:
   1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power, and data connectivity for instructor and each attendee.
   2. Instructor shall provide training materials, projector, and other audiovisual equipment used in training.
   3. Provide as much of training located on-site as deemed feasible and practical by Owner.
   4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration, and service requirements.
   5. The workstation provided with the system shall be used in training. If workstation is not indicated, provide a temporary workstation to convey training content.

G. Off-Site Training:

1. Provide conditioned training rooms and workspace with ample tables, chairs, power, and data connectivity for each attendee.
2. Provide capability to remotely access to Project monitoring and control system for use in training.
3. Provide a workstation for use by each attendee.

**3.10 AT COMPLETION OF TRAINING:**

A. Staff familiar with the system installed are capable of demonstrating operation of the system during final review.

B. Demonstration shall include, but not be limited to, the following:
   1. Accuracy and calibration of **10** I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
   2. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and workstations.
   3. Trends, summaries, logs, and reports set-up for Project.
   4. Software's ability to communicate with controllers, workstations, and uploading and downloading of control programs.
   5. Software's ability to edit control programs off-line.
   6. Data entry to show Project-specific customizing capability including parameter changes.
   7. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
   8. Execution of digital and analog commands in graphic mode.
   9. Spreadsheet and curve plot software and its integration with database.
   10. Online user guide and help functions.
   11. For Each Meter:
      a. Memory: Programmed data, parameters, trend, and alarm history collected during normal operation is not lost during power failure.
      b. Operator Interface: Ability to connect directly to each meter with a portable workstation.
      c. Wiring Labels: Match control drawings.
      d. Network Communication: Ability to locate a meter on the network. Communication architecture matches Shop Drawings.
      e. Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators, and devices.
   12. For Each Workstation:
      a. I/O point lists agree with naming conventions.
      b. Graphics are complete.
      c. UPS unit, if applicable, operates.

**END OF SECTION 26 09 13**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 22 13 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
  1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
  3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For testing agency.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Accredited by NETA.
  1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING
- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
  1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

1.8 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cutler Hammer.
   2. General Electric Company.
   3. Square D; by Schneider Electric.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

### 2.3 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Comply with NFPA 70.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Transformers Rated 15 kVA and Larger:
   1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
   2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

### 2.4 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70.

B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
   1. One leg per phase.
   2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
   3. Grounded to enclosure.

C. Coils: Continuous windings without splices except for taps.
   1. Coil Material: Copper.
   2. Internal Coil Connections: Brazed or pressure type.
   3. Terminal Connections: Welded.

D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

E. Enclosure: Ventilated.
   1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound using a vacuum-pressure impregnation process to seal out moisture and air.

2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
3. Wiring Compartment: Sized for conduit entry and wiring installation.
4. Finish: Comply with NEMA 250.
    a. Finish Color: ANSI 61 gray weather-resistant enamel.

F. Taps for Transformers 3 kVA and Smaller: One 5 percent tap above normal full capacity.

G. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.

H. Insulation Class, Smaller than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

I. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

J. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.

K. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
1. 9.01 to 30.00 kVA: 45 dBA.

## 2.5 IDENTIFICATION

A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## 2.6 SOURCE QUALITY CONTROL

B. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
2. Ratio tests at rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:
    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.
9. Temperature tests.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
F. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. Construct concrete bases and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
   1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
B. Secure transformer according to manufacturer's written instructions.
C. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
D. Remove shipping bolts, blocking, and wedges.

## 3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

## 3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
B. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
   1. Visual and Mechanical Inspection.
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, and grounding.
      c. Verify that resilient mounts are free and that any shipping brackets have been removed.
      d. Verify the unit is clean.
      e. Perform specific inspections and mechanical tests recommended by manufacturer.

f. Verify that as-left tap connections are as specified.
g. Verify the presence of surge arresters and that their ratings are as specified.

2. Electrical Tests:
   a. Measure resistance at each winding, tap, and bolted connection.
   b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
   c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
   d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
   1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
   3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

## 3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

## 3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**END OF SECTION 26 22 13**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 24 13 - SWITCHBOARDS**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

CC. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:
   1. Service and distribution switchboards rated 600 V and less.
   2. Disconnecting and overcurrent protective devices.
   3. Instrumentation.
   4. Control power.
   5. Accessory components and features.
   6. Identification.
   7. Mimic bus.

B. Related Requirements
   1. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.
   2. Section 264313 “Surge Protection for Low-Voltage Electrical Power Circuits” for SPD requirements.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
   1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
   5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
   6. Detail utility company's metering provisions with indication of approval by utility company.
   7. Include evidence of NRTL listing for series rating of installed devices.
   8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
   10. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Delegated Design Submittal:
   1. For arc-flash hazard analysis.
   2. For arc-flash labels.

## 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Field Quality-Control Reports:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

## 1.5 CLOSEOUT SUBMITTALS

C. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Routine maintenance requirements for switchboards and all installed components.
      b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
      c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
   2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
   4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
   5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
   6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

## 1.7 QUALITY ASSURANCE

B. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
C. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.
C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

## 1.9 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
B. Environmental Limitations:
   1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding 104 deg F.
      b. Altitude: Not exceeding 6600 feet.
C. Unusual Service Conditions: NEMA PB 2, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet.
D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Construction Manager's written permission.
   4. Comply with NFPA 70E.

## 1.10 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

## 1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion.
B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

## 1.12 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION MOTOR CONTROL CENTER** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
2.2 SWITCHBOARDS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allen Bradley.
   2. Cutler Hammer.
   3. General Electric Company.
   4. Square D; by Schneider Electric.
B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
E. Comply with NEMA PB 2.
F. Comply with NFPA 70.
G. Comply with UL 891.
H. Front-Connected, Front-Accessible Switchboards:
   1. Main Devices: Panel mounted.
   2. Branch Devices: Panel mounted.
   3. Sections front and rear aligned.
I. Nominal System Voltage: 480Y/277 V.
J. Main-Bus Continuous: 400 A.
K. Indoor Enclosures: Steel, NEMA 250, Type 1.
L. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
M. Barriers: Between adjacent switchboard sections.
N. Insulation and isolation for main and vertical buses of feeder sections.
O. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
2. Space-Heater Power Source: 120-V external branch circuit.

P. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain two service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

Q. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

R. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.

S. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

T. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

U. Pull Box on Top of Switchboard:
1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
3. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
4. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

V. Buses and Connections: Three phase, four wire unless otherwise indicated.
1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
3. Copper feeder circuit-breaker line connections.
4. Ground Bus: 1/4-by-2-inch- hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections.
6. Disconnect Links:
   a. Isolate neutral bus from incoming neutral conductors.
   b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
7. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
8. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

W. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

X. Switchboard, ATS and MCC shall be furnished by the same manufacturer.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long and short time adjustments.
      d. Ground-fault pickup level, time delay, and I squared t response.
   2. MCCB Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
      d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
         1) Each main circuit breaker shall include a multifunction digital meter with a readout and a means to output a three phase voltage analog signal to the SCADA panel. Ethernet Modbus TCP/IP communications shall be included in the metering.
      f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
      g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
      h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, and the following:
   1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
   2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
   1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
      a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
      b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
      c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
      d. Megawatts: Plus or minus 1 percent.
      e. Megavars: Plus or minus 1 percent.
      f. Power Factor: Plus or minus 1 percent.
      g. Frequency: Plus or minus 0.1 percent.

h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semi flush mounted in instrument compartment door.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied from remote branch circuit.
B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
B. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.7 IDENTIFICATION

A. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
B. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
C. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage per manufacturer's instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete.
   1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to switchboards.
   6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, surge protection devices, and instrumentation.
   1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Install spare-fuse cabinet.

H. Comply with NECA 1.

3.3 CONNECTIONS

A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

B. Support and secure conductors within the switchboard according to NFPA 70.

C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
   1. Acceptance Testing:

a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment per NFPA 70.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. Perform the following infrared scan tests and inspections, and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:
      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Switchboard will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

**END OF SECTION 26 24 13**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 24 19 - MOTOR-CONTROL CENTERS**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes MCCs for use with ac circuits rated 600 V and less, with combination controllers and having the following factory-installed components:
   1. Automatic power transfer.
   2. Feeder-tap units.
   3. Measurement and control.
   4. Auxiliary devices.
   5. Panelboards.

B. Related Requirements
   1. Section 262213 “Low-Voltage Distribution Transformers” for the 480-208/120 V transformer requirements.
   2. Section 262413 “Switchboards” for the main incoming service requirements.
   3. Section 263600 “Transfer Switches” for transferring between the two power sources.

### 1.3 DEFINITIONS

A. CPT: Control power transformer.
B. MCC: Motor-control center.
C. MCCB: Molded-case circuit breaker.
D. MCP: Motor-circuit protector.
E. OCPD: Overcurrent protective device.
F. PID: Control action; proportional plus integral plus derivative.
G. PT: Potential transformer.
H. SPD: Surge protective device.
I. SCR: Silicon-controlled rectifier.
J. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

### 1.4 ACTION SUBMITTALS

K. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for MCCs.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for each cell of the MCC.

L. Shop Drawings: For each MCC, manufacturer's approval and production drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting

arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    a. Each installed unit's type and details.
    b. Factory-installed devices.
    c. Enclosure types and details.
    d. Nameplate legends.
    e. Short-circuit current (withstand) rating of complete MCC, and for bus structure and each unit.
    f. Features, characteristics, ratings, and factory settings of each installed controller and feeder device, and installed devices.
    g. Specified optional features and accessories.
2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring for each installed controller.
3. Nameplate legends.
4. Vertical and horizontal bus capacities.
5. Features, characteristics, ratings, and factory settings of each installed unit.

## 1.5 INFORMATIONAL SUBMITTALS

A. Standard Drawings: For each MCC, as defined in UL 845.
B. Production Drawings: For each MCC, as defined in UL 845.
C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around MCCs where pipe and ducts are prohibited. Show MCC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
D. Qualification Data: For testing agency.
E. Product Certificates: For each MCC.
F. Source quality-control reports.
G. Field quality-control reports.
H. Load-Current and Overload Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
I. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.
J. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

K. Operation and Maintenance Data: For MCCs, all installed devices, and components to include in emergency, operation, and maintenance manuals.
    1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    2. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL 845, include field modifications and field-assigned wiring identification incorporated during construction by manufacturer, Contractor, or both.

3. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
4. Manufacturer's written instructions for setting field-adjustable overload relays.
5. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

L. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

## 1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
B. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and marked for intended use.
D. UL Compliance: MCCs shall comply with UL 845 and shall be listed and labeled by a qualified testing agency.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver MCCs in shipping splits of lengths that can be moved past obstructions in delivery paths.
B. Handle MCCs according to the following:
1. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."
2. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
C. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside MCCs; connect factory-installed space heaters to temporary electrical service.

## 1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace MCC and SPD that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

**1.11 BASIS OF PAYMENT**

A. The work shall be paid at the contract lump sum price for **PUMP STATION MOTOR CONTROL CENTER** which shall be payment in full for the work described herein.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS
2.2 Motor-Control Center shall be manufactured by Allen Bradley, no substitutions allowed.

2.3 SYSTEM DESCRIPTION
- A. NEMA Compliance: Fabricate and label MCCs to comply with NEMA ICS 18.
- B. Ambient Environment Ratings:
  1. Ambient Temperature Rating: Not less than 0 deg F and not exceeding 104 deg F, with an average value not exceeding 95 deg F over a 24-hour period.
  2. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
  3. Humidity Rating: Less than 95 percent (noncondensing).
  4. Altitude Rating: Not exceeding 6600 feet, or 3300 feet if MCC includes solid-state devices.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Switchboard, ATS and MCC shall be furnished by the same manufacturer.

2.4 PERFORMANCE REQUIREMENTS
- A. Capacities and Characteristics:
  1. MCC Enclosure and Assembly:
     a. Nominal System Voltage: 277/480-V ac.
     b. Service Equipment Rated: No.
     c. Enclosure: NEMA 250, Type 12.
  2. Integrated Short-Circuit Rating for MCC:
     a. Fully rated; 65 kA.
  3. Bus:
     a. Horizontal Bus: 65 kA.
     b. Neutral Bus: Full size.
  4. Panelboards: Tag Number LP-38.
     a. Mains: MCCB, 3 phase, 120 V, 60 A.
     b. Plug-in circuit breakers.

2.5 MOTOR CONTROL CENTER ENCLOSURES
- A. Indoor Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, Type 12 unless otherwise indicated to comply with environmental conditions at installed location.
- B. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
  1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
  2. Space-Heater Power Source: 120-V external branch circuit.
- C. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

2.6 MOTOR CONTROL CENTER STARTERS

A. The motor starters shall be full voltage, non-reversing, across the line type.

B. The motor starters shall include circuit breaker disconnects, electronic solid state type overload relays, and dedicated control power transformers to derive 120 volts for the control circuits.

C. Motor starter bucker door for the main and low flow pumps shall contain sufficient space for the installation of the pump manufacturer's furnished motor protection relay.

D. Motor starter buckets shall contain a current sensing relay equipped with a means to output an analog signal of the motor current to the SCADA panel.

E. Each pump starter shall be provided with a non-resettable pump run duration monitor (in hours) and non-resettable starts counter. Devices shall be located on the front of the starter buckets.

2.7 ASSEMBLY

A. Structure:

1. Units up to and including Size 3 shall have draw-out mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
2. Units in Type B and Type C MCCs shall have pull-apart terminal strips for external control connections.
3. Pull Boxes:
   a. Include provisions for ventilation to maintain temperature in pull box within same limits as the MCC.
   b. Covers: Removable covers forming top, front, and sides.
   c. Insulated bottom of fire-resistive material with separate holes for cable drops into MCC.
   d. Cable Supports: Arranged to facilitate cabling and adequate to support cables, including supports for future cables.
   e. When equipped with barriers, supply with access to check bus bolt tightness.

B. Compartments: Modular; individual lift-off doors with concealed hinges and quick-captive screw fasteners.

1. Interlock compartment door to require that the disconnecting means is "off" before door can be opened or closed, except by operating a concealed release device.
2. Compartment construction shall allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC.
3. The same-size compartments shall be interchangeable to allow rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.

C. Bus Transition and Incoming Pull Sections: Included and aligned with the structure of the MCC.

D. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same-size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.

E. Wiring Spaces:

1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.
2. Horizontal wireways in top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

F. Provisions for Future:

1. Compartments marked "future" shall be bused, wired and equipped with guide rails or equivalent, and ready for insertion of draw-out units.
2. Compartments marked "spare" shall include provisions for connection to the vertical bus.

G. Integrated Short-Circuit Rating:
1. Short-Circuit Current Rating of MCC: Fully rated with its main overcurrent device; 65 kA.

H. Control Power:
1. 120-V ac, supplied centrally from a remote branch circuit.

I. Factory-Installed Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
1. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

J. Bus:
1. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections.
2. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.
3. Phase- and Neutral-Bus Material: tin-plated copper busses, with mechanical connectors for outgoing conductors.
4. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for ground conductors, minimum size 1/4-by-2 inches minimum. Equip with mechanical connectors for outgoing conductors.
5. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Insulation temperature rating shall not be less than 105 deg C.

2.8 MEASUREMENT AND CONTROL DEVICES

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
1. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
2. CPTs: Dry type, mounted in separate compartments for units larger than 3 kVA.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Listed or recognized by a nationally recognized testing laboratory.
2. Inputs from sensors or 5-A current-transformer secondary's, and potential terminals rated to 600 V.
3. Switch-selectable digital display of the following values with the indicated maximum accuracy tolerances:
a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Three-Phase Real Power (Megawatts): Plus or minus 2 percent.
e. Three-Phase Reactive Power (Megavars): Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.

i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.

4. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1. 4-inch diameter or 6 inches square, flush or semiflush, with antiparallax 250-degree scale and external zero adjustment.
1. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
2. Feeder Ammeters: 2-1/2-inch minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for feeder circuits, unless otherwise indicated.

D. Instrument Switches: Rotary type with off position.
1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and phase-to-neutral voltages where a neutral is included.
2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondary's in a closed-circuit condition at all times.

E. Watt-Hour Meters and Wattmeter's:
1. Comply with ANSI C12.1.
2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
3. Suitable for connection to three- and four-wire circuits.
4. Potential indicating lamps.
5. Adjustments for light and full load, phase balance, and power factor.
6. Four-dial clock register.
7. Integral demand indicator.
8. Contact devices to operate remote impulse-totalizing demand meter.
9. Ratchets to prevent reverse rotation.
10. Removable meter with draw-out test plug.
11. Semiflush mounted case with matching cover.
12. Appropriate multiplier tag.

F. Control Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

2.9 FEEDER TAP UNITS

A. MCCBs (to 1200 A): Fixed mounted, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. Comply with UL 489, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
1. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time time adjustments.
d. Ground-fault pickup level, time delay, and $I^2t$ response.
3. With built-in digital ammeter and a digital display, showing tripping cause.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
7. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Zone-Selective Interlocking: Integral with electronic ground-fault trip unit; for interlocking ground-fault protection function.

2.10 COMMUNICATIONS

A. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."

B. Equipment shall be provided with an unmanaged Ethernet switch connected to the station control system. Within the switchgear, the protective relays, power meters and PLC shall be connected to the Ethernet switch. Line-to-line voltage, line-to-neutral voltage, current for each phase, neutral current, frequency, power factor, kilowatts, kilowatt-hours, and reactive power at a minimum shall be communicated over Modbus TCP/IP.

C. The following signals are to be provided to the PLC:
1. Pump circuit breaker position indication (and trip indication when applicable)
2. Pump overload
3. Pump HOA switch in auto
4. Pump overtemp
5. Pump moisture (seal fail)
6. Pump bearing overtemp
7. Pump running
8. Pump current – analog 4-20 mA signal derived from current transformer within MCC bucket
9. Ability to accept call signals from SCADA
10. Ability to accept motor protection relay override signal from SCADA

D. The following hardwired dry contacts shall be provided to the PLC from the incoming main breakers (ComEd and Generator):
1. Normal electric service main breaker position indication and trip indication
2. Normal electric service ground fault
3. Normal electric service failure
4. Emergency electric service main breaker position indication and trip indication
5. Emergency electric service ground fault
6. Emergency electric service failure

2.11 PANELBOARDS

A. Comply with NEMA PB 1.

B. Branch OCPDs for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.

C. Branch OCPDs for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers; or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.12 SOURCE QUALITY CONTROL

A. MCC Testing: Test and inspect MCCs according to requirements in NEMA ICS 18.

B. MCCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine areas and surfaces to receive MCCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. NEMA Industrial Control and Systems Standards: Comply with parts of NEMA ICS 2.3 for installation and startup of MCCs.

B. Floor Mounting: Install MCCs on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in each fusible switch.

E. Install fuses in control circuits if not factory installed.

F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

H. Install power factor correction capacitors. Connect to the load side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the motor full-load currents.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.

1. Identify field-installed conductors, interconnecting wiring, and components.
2. Install required warning signs.
3. Label MCC and each cubicle with engraved nameplate.
4. Label each enclosure-mounted control and pilot device.
5. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.

B. Operating Instructions: Frame printed operating instructions for MCCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of MCCs.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between master terminal boards and remote devices and facility's central-control system. Comply with requirements in Section 260519 “Low-Voltage Electrical Power Conductors and Cables”

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.
   1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
   2. Connect selector switches within enclosed controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 CONNECTIONS

A. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   4. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multipole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multipole enclosed controller 11 months after date of Substantial Completion.
      c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Submit calibration record for device.
   5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
   6. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.

D. MCCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to NETA Acceptance Testing Specification and manufacturer's written instructions.

3.8 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload relay pickup and trip ranges.

B. Adjust overload relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in solid-state controllers.

E.

F. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based solid-state controllers.

**END OF SECTION 26 24 19**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 27 13 - ELECTRICITY METERING**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes electricity metering.

1.3 DEFINITIONS
- A. KY or KYZ Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity (kWh) that is based on a relay opening and closing in response to the rotation of the disk in the meter. Electronic meters generate pulses electronically.

1.4 ACTION SUBMITTALS
- A. Product Data:
  1. For each type of meter.
  2. For metering infrastructure components.
  3. For metering software.
- B. Shop Drawings: For electricity-metering equipment.
  1. Include elevation views of front panels of control and indicating devices and control stations.
  2. Include diagrams for power, signal, and control wiring.
  3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
  4. Include series-combination rating data for modular meter centers with main disconnect device.
  5. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

1.5 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Submit evidence that meters are compatible with connected monitoring and control devices.
  1. Show interconnecting signal and control wiring, and interface devices to show compatibility of meters.
  2. For reporting and billing interfaces and adapters, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the protocol.
- B. Qualification Data: For testing agency.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Application and operating software documentation.
   2. Software licenses.
   3. Software service agreement.
   4. Device address list.
   5. Hard copies of manufacturer's operating specifications, user's guides for software and hardware, and PDF files on a USB storage device of hard-copy Submittal.
   6. Meter data sheet for each meter, listing nameplate data and serial number, accuracy certification, and test results.
   7. Meter installation and billing software startup report.

1.7 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Construction Manager shall be notified and issued written permission no fewer than two days in advance of proposed interruption of electrical service.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Damage from transient voltage surges.
   2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
   3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

1.10 COORDINATION

A. Electrical Service Connections:
   1. Coordinate with utility companies and utility-furnished components.
      a. Comply with requirements of utility providing electrical power services.
      b. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

1.11 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 916.

## 2.2 UTILITY METERING INFRASTRUCTURE

A. Install metering accessories furnished by the utility company, complying with its requirements.
B. Utility-Furnished Meters: Connect data transmission facility of metering equipment installed by the Utility.
C. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
D. Meter Sockets:
   1. Comply with requirements of electrical-power utility company.
E. Modular Meter Center: Factory-coordinated assembly of a main service disconnect device, wireways, meter socket modules, and feeder circuit breakers arranged in adjacent vertical sections complete with interconnecting buses.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Eaton.
      b. General Electric Company.
      c. Square D; by Schneider Electric.

   2. Comply with requirements of utility company for meter center.
      a. Comply with UL 67.
   3. Housing: NEMA 250, Type 3R enclosure.
   4. Meter Socket Rating: Coordinated with connected feeder circuit rating.
   5. Minimum Short-Circuit Rating: 65,000 A symmetrical at rated voltage.
   6. Steady-state and short-circuit current ratings shall have ratings that match connected circuit ratings.
   7. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers and having an adjustable magnetic trip setting for circuit-breaker frame sizes of 250 A and larger. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers." Circuit breakers shall be operable from outside the enclosure to disconnect the unit. Configure cover so it can be opened only when the disconnect switch is open.
F. Arc-Flash Warning Labels;
   1. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 260553 "Identification for Electrical Systems." Apply a 3-1/2-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
      a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
         1) Location designation.
         2) Nominal voltage.
         3) Flash protection boundary.
         4) Hazard risk category.
         5) Incident energy.
         6) Working distance.
         7) Engineering report number, revision number, and issue date.

## 2.3 ELECTRICITY METERS

A. System Description: Able to meter designated activity loads, with or without external alarm, control, and communication capabilities, or other optional features. Meter to be provided by and installed by ComEd.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.
B. Install arc-flash labels as required by NFPA 70.
C. Wiring Method:
   1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
   2. Install unshielded, twisted-pair cable for control and signal transmission conductors, per ComEd requiring.
   3. Minimum conduit size shall be 1/2 inch.

## 3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Series Combination Warning Label: Self-adhesive labels, with text as required by NFPA 70.
   2. Equipment Identification Labels: Self-adhesive labels with clear protective overlay.

## 3.3 FIELD QUALITY CONTROL

A. Verify location of Metering Equipment.
B. Verify that electrical power is available and of correct characteristics.

**END OF SECTION 26 27 13**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 27 26 - WIRING DEVICES**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:
   1. Standard-grade receptacles, 125 V, 20 A.
   2. GFCI receptacles, 125 V, 20 A.
   3. Hazardous (classified) location receptacles.
   4. Pendant cord-connector devices.
   5. Digital timer light switches.
   6. Wall plates.
   7. Prefabricated multioutlet assemblies.
   8. Service poles.

### 1.3 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.
B. BAS: Building automation system.
C. EMI: Electromagnetic interference.
D. GFCI: Ground-fault circuit interrupter.
E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
F. RFI: Radio-frequency interference.
G. SPD: Surge protective device.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
C. Samples: One for each type of device and wall plate specified, in each color specified.

### 1.5 INFORMATIONAL SUBMITTALS

B. Field quality-control reports.

### 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### 1.7 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

**PART 2 - PRODUCTS**

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

F. Device Color:

1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.

G. Wall Plate: Stainless Steel.

H. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 HOSPITAL-GRADE RECEPTACLES, NEMA 5-20R, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Lutron.
   b. Eaton (Arrow Hart).
   c. Hubbell Incorporated; Wiring Device-Kellems.
   d. Leviton Manufacturing Co., Inc.
2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Lutron.
   b. Eaton (Arrow Hart).
   c. Hubbell Incorporated; Wiring Device-Kellems.
   d. Leviton Manufacturing Co., Inc.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

C. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.

3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
   2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
   3. Configuration: NEMA WD 6, Configuration 5-15R.
   4. Type: Non-feed through.
   5. Standards: Comply with UL 498 and UL 943 Class A.
   6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Hazardous (Classified) Locations Receptacles are identified as wetwell and drywell:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Eaton (Arrow Hart).
      b. EGS/Appleton Electric.
      c. Killark.
   2. Description: Pin and sleeve receptacle with matching connector.
   3. Class 1.
      a. Division: 2.
      b. Group: D.
   4. Voltage: 120 V ac.
   5. Hertz: 60 Hz.
   6. Amperage: 20 A.
   7. Wires and Poles: Three wire, three pole.
   8. Standards: Comply with NEMA FB 11 and UL 1203.

2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.
B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Eaton (Arrow Hart).
   2. Hubbell Premise Wiring.
   3. Leviton Manufacturing Co., Inc.
C. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R.
D. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.

E. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.
F. Standards: Comply with FS W-C-596.

2.6 TIMER LIGHT SWITCH

A. Digital Timer Light Switch:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Lutron.
b. Eaton (Arrow Hart).
c. Hubbell Incorporated; Wiring Device-Kellems.
d. Leviton Manufacturing Co., Inc.
2. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 20-minute increments.
3. Standards: Comply with UL 20.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Integral relay for connection to BAS.

2.7 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
B. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.
D. Antimicrobial Cover Plates:
1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Tarnish resistant.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
B. Coordination with Other Trades:
1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
   4. Existing Conductors:
      a. Cut back and pigtail, or replace all damaged conductors.
      b. Straighten conductors that remain and remove corrosion and foreign matter.
      c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:
   1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
   4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
   5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
   6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
   7. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
   8. Tighten unused terminal screws on the device.
   9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
   1. Install dimmers within terms of their listing.
   2. Verify that dimmers used for fan-speed control are listed for that application.
   3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.

C. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

D. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

**END OF SECTION 26 27 26**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART 1 - GENERAL**

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

1.2 SUMMARY
- A. Section Includes:
  1. Molded-case circuit breakers (MCCBs).

1.3 DEFINITIONS
- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS
- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  1. Enclosure types and details for types other than NEMA 250, Type 1.
  2. Current and voltage ratings.
  3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
  5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
  1. Include plans, elevations, sections, details, and attachments to other work.
  2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
     a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
     b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.7 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Accredited by NETA.
  1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 3 year(s) from date of Substantial Completion.

1.10 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION MOTOR CONTROL CENTER** which shall be payment in full for the work described herein.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
D. Comply with NFPA 70.

2.2 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be of the same manufacturer as the Motor Control Center.
B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.
E. MCCBs shall have the ability to be locked out and tagged out.
F. Lugs shall be suitable for 194 deg F rated wire, sized according to the 167 deg F temperature rating in NFPA 70.
G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

O. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
   4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
   6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
   9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
   10. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
   11. Electrical Operator: Provide remote control for on, off, and reset operations.
   12. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Construction Manager's written permission.
   4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that the unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the two following methods:
         1) Use a low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those

of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.

i. Verify correct phase barrier installation.

j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that the unit is clean.

e. Operate the circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
   e. Determine the following by primary current injection:
      1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
   f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
   g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
   h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
   b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.
1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

**END OF SECTION 26 28 16**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 32 13.16 - GASEOUS EMERGENCY ENGINE GENERATORS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes packaged engine generators for emergency use with the following features:
  1. Natural gas engine.
  2. Gaseous fuel system.
  3. Control and monitoring.
  4. Generator overcurrent and fault protection.
  5. Generator, exciter, and voltage regulator.
  6. Load banks.
  7. Outdoor engine generator enclosure.
  8. Remote radiator motors.
  9. Vibration isolation devices.
  10. Finishes.
- B. Related Requirements:
  1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.
  2. Section 284621.11 “Addressable Fire-Alarm Systems”

1.3 DEFINITIONS
- A. EPS: Emergency power supply.
- B. EPSS: Emergency power supply system.
- C. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  2. Include thermal damage curve for generator.
  3. Include time-current characteristic curves for generator protective device.
  4. Include fuel consumption in cubic feet per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
  5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
  6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
  7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.
- B. Shop Drawings:
  1. Include plans and elevations for engine generator and other components specified.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and supported equipment. Include base weights.
5. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.
B. Source Quality-Control Reports: Including, but not limited to, the following:
   1. Certified summary of prototype-unit test report.
   2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
   3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   4. Report of sound generation.
   5. Report of exhaust emissions showing compliance with applicable regulations.
   6. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
C. Field quality-control reports.
D. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
   2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
   4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years from date of Substantial Completion.

1.10 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION PACKAGE ENGINE GENERATOR SYSTEMS** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Caterpillar, Inc.; Electric Power Division.
   2. Generac Power Systems, Inc.

3. Kohler Power Systems.

B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. B11 Compliance: Comply with B11.19.

B. NFPA Compliance:
1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 99.
4. Comply with NFPA 110 requirements for Level 2 EPSS.

C. UL Compliance: Comply with UL 2200.

D. Engine Exhaust Emissions: Comply with EPA Tier 3 requirements and applicable state and local government requirements.

E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator, including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
1. Ambient Temperature: 41 to 104 deg F.
2. Relative Humidity: Zero to 95 percent.
3. Altitude: Sea level to 1000 feet.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Service Load: 142 kW / 177.5 kVA.

D. Power Factor: 0.8, lagging.

E. Frequency: 60 Hz.

F. Voltage: 480-V ac.

G. Phase: Three-phase, four-wire wye.

H. Induction Method: Naturally aspirated.

I. Governor: Adjustable isochronous, with speed sensing.

J. Mounting Frame: Structural-steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.

K. Capacities and Characteristics:
1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

L. Engine Generator Performance:
1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage, from no load to full load.

2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency, from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.4 ENGINE

A. Fuel: Natural gas.
B. Rated Engine Speed: 1800 rpm.
C. Lubrication System: Engine or skid mounted.
   1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
   2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
   3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and with UL 499.
E. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
   1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
   2. Size of Radiator: Adequate to contain expansion of total system coolant, from cold start to 110 percent load condition.
      a. Airflow after the radiator is to be ducted to exhaust out of the generator building.
   3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
   4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
      a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
      b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
   1. Minimum sound attenuation of 25 dB at 500 Hz.
   2. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 78 dBA or less.
   3. Engine exhaust to be insulated and piped out of generator building

G. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

H. Starting System: 24-V electric, with negative ground.
   1. Components: Sized so they are not damaged during a full engine-cranking cycle, with ambient temperature at maximum specified in "Performance Requirements" Article.
   2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
   3. Cranking Cycle: 60 seconds.
   4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
   5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
   6. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
   7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
   8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
      a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
      b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
      c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
      d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
      e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
      f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 GASEOUS FUEL SYSTEM

A. Natural Gas Piping: Comply with requirements in Section 231123 "Facility Natural Gas Piping."

B. Gas Train: Comply with NFPA 37.
C. Engine Fuel System:
1. Natural Gas, Vapor-Withdrawal System:
a. Carburetor.
b. Secondary Gas Regulators: One for each fuel type, with atmospheric vents piped to building exterior.
c. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves.
2. Fuel Filters: One.
3. Manual Fuel Shutoff Valves: One.
4. Flexible Fuel Connectors: One.
5. LP gas flow adjusting valve.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
B. Manual Starting System Sequence of Operation: Switching On-Off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
C. Provide minimum run-time control set for 30 minutes, with override only by operation of a remote emergency-stop switch.
D. Comply with UL 508A.
E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.
1. Switchboard Construction: Freestanding unit complying with Section 262413 "Switchboards." Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
F. Control and Monitoring Panel:
1. Digital controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Instruments: Located on the control and monitoring panel and viewable during operation.
a. Engine lubricating-oil pressure gage.
b. Engine-coolant temperature gage.
c. DC voltmeter (alternator battery charging).
d. Running-time meter.
e. AC voltmeter, connected to a phase selector switch.
f. AC ammeter, connected to a phase selector switch.
g. AC frequency meter.
h. Generator-voltage adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication as required by NFPA 110 for Level 2 system, including the following:
    a. Cranking control equipment.
    b. Run-Off-Auto switch.
    c. Control switch not in automatic position alarm.
    d. Overcrank alarm.
    e. Overcrank shutdown device.
    f. Low water temperature alarm.
    g. High engine temperature.
    h. High engine temperature shutdown device.
    i. Overspeed alarm.
    j. Overspeed shutdown device.
    k. Coolant low-level alarm.
    l. Coolant high-temperature alarm.
    m. Coolant high-temperature shutdown device.
    n. EPS load indicator.
    o. Battery high-voltage alarm.
    p. Low-cranking voltage alarm.
    q. Battery-charger malfunction alarm.
    r. Battery low-voltage alarm.
    s. Lamp test.
    t. Contacts for local and remote common alarm.
    u. Remote manual-stop shutdown device.
    v. Air shutdown damper alarm when used.
    w. Air shutdown damper shutdown device when used.
    x. Generator overcurrent-protective-device not-closed alarm.

G. Connection to Datalink:
1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
2. Provide connections for datalink transmission of indications to remote data terminals via ModBus TCP/IP.
3. Data to be communicated to the PLC
    a. Generator Common Alarm
    b. Generator Running
    c. Generator ‘not in auto’
    d. Generator emergency stop
    e. Ability to accept start and stop signals
    f. Ability to send ready to load signal to transfer switch
    g. Generator voltage, kilowatts, and amps – soft point derived from generator breaker in Switchboard; communication over Ethernet

H. Common Remote Panel with Common Audible Alarm: Comply with NFPA 110 requirements for Level 2 systems. Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.

I. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

J. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
   1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
   1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
   2. Trip Settings: Selected to coordinate with generator thermal damage curve.
   3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
   4. Mounting: Adjacent to or integrated with control and monitoring panel.

C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other engine generator protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
   1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other engine generator malfunction alarms. Contacts shall be available for load shed functions.
   2. Under single- or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
   3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
   4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

D. Ground-Fault Indication: Comply with NFPA 70 Article 700, "Emergency System" signals for ground fault.
   1. Indicate ground fault with other engine generator alarm indications.
   2. Trip generator protective device on ground fault.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide 12-lead alternator.

E. Range: Provide broad range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
   1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.

2. Maintain voltage within 20 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 15percent and stabilize at rated frequency within five seconds.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
K. Subtransient Reactance: 12 percent, maximum.

2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
B. Description: Prefabricated or preengineered, galvanized-steel-clad, integral structural-steel-framed, enclosure; erected on concrete foundation.
C. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.
D. Fire Protection: Provide flame detector in enclosure; mounted according to NFPA 72. Refer to Section 284621.11 “Addressable Fire-Alarm Systems” for details.
E. Hinged Doors: With padlocking provisions.
F. Space Heater: Thermostatically controlled and sized to prevent condensation.
G. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
H. Muffler Location: External to enclosure.
I. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.
    1. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers prevent entry of rain and snow.
    2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
    3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
    1. Material: Standard neoprene separated by steel shims.
    2. Minimum Deflection: 1 inch.
B. Comply with requirements in Section 232116 "Hydronic Piping Specialties" for vibration isolation and flexible connector materials for steel piping.
C. Comply with requirements in Section 233113 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.
D. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
   1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   2. Test generator, exciter, and voltage regulator as a unit.
   3. Full-load run.
   4. Maximum power.
   5. Voltage regulation.
   6. Transient and steady-state governing.
   7. Single-step load pickup.
   8. Safety shutdown.
   9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
   10. Report factory test results within 10 days of completion of test.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections to verify actual locations of connections before packaged engine generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Construction Manager no fewer than two working days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

3.3 INSTALLATION

A. Comply with NECA 1 and NECA 404.

B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.

C. Equipment Mounting:
   1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
   2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
   3. Remote Radiators:

a. Install remote radiator with elastomeric isolator pads on concrete base on grade.
b. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Section 077200 "Roof Accessories."

D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
E. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."
1. Install isolating thimbles where exhaust piping penetrates combustible surfaces. Provide a minimum of 9 inches of clearance from combustibles.
2. Insulate cooling-system piping and components according to requirements in Section 230719 "HVAC Piping Insulation."
F. Exhaust System: Install Schedule 40 black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.
1. Install flexible connectors and steel piping materials according to requirements in Section 232116 "Hydronic Piping Specialties."
2. Insulate muffler/silencer and exhaust system components according to requirements in Section 230719 "HVAC Piping Insulation."
3. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches of clearance from combustibles.
G. Drain Piping: Install condensate drain piping to muffler drain outlet with a shutoff valve, stainless-steel flexible connector, and Schedule 40 black steel pipe with welded joints.
H. Gaseous Fuel Piping:
1. Natural gas piping, valves, and specialties for gas distribution are specified in Section 231123 "Facility Natural Gas Piping."
I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 CONNECTIONS

A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
B. Connect cooling-system water piping to engine generator and heat exchanger with flexible connectors.
C. Connect engine exhaust pipe to engine with flexible connector.
D. Gaseous Fuel Connections:
1. Connect fuel piping to engines with a gate valve and union and flexible connector.
2. Install manual shutoff valve in a remote location to isolate gaseous fuel supply to the generator.
3. Vent gas pressure regulators outside building a minimum of 60 inches from building openings.
E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
G. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.5 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.
    a. Visual and Mechanical Inspection:
        1) Compare equipment nameplate data with Drawings and the Specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify that the unit is clean.
    b. Electrical and Mechanical Tests:
        1) Perform insulation-resistance tests according to IEEE 43.
            a) Machines Larger Than 200 hp Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 hp or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
        2) Test protective relay devices.
        3) Verify phase rotation, phasing, and synchronized operation as required by the application.
        4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
        5) Perform vibration test for each main bearing cap.
        6) Conduct performance test according to NFPA 110.
        7) Verify correct functioning of the governor and regulator.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that

back pressure at full-rated load is within manufacturer's written allowable limits for the engine.

7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.
D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
H. Remove and replace malfunctioning units and retest as specified above.
I. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
K. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels, so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

**END OF SECTION 26 32 13.16**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 36 00 - TRANSFER SWITCHES**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes automatic transfer switches rated 600 V and less, including the following:
  1. Bypass/isolation switches.
  2. Remote annunciator system.
  3. Remote annunciator and control system.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
  2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
  1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
  2. Include material lists for each switch specified.
  3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
  4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For manufacturer-authorized service representative.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
     a. Features and operating sequences, both automatic and manual.
     b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE
- A. Testing Agency Qualifications:
  1. Member company of NETA.
     a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS
- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
  1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 12 months from date of Substantial Completion.

1.9 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION MOTOR CONTROL CENTER** which shall be payment in full for the work described herein.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NEMA ICS 1.
C. Comply with NFPA 99.
D. Comply with NFPA 110.
E. Comply with UL 1008 unless requirements of these Specifications are stricter.
F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
   1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
   2. Short-time withstand capability for three cycles.
H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
K. Service-Rated Transfer Switch:
   1. Comply with UL 869A and UL 489.
   2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
   3. In systems with a neutral, the bonding connection shall be on the neutral bus.
   4. Provide removable link for temporary separation of the service and load grounded conductors.
   5. Surge Protective Device: Service rated.
   6. Ground-Fault Protection: Comply with UL 1008 for normal bus.
   7. Service Disconnecting Means: Externally operated, manual mechanically actuated.

L. Neutral Switching: Provide neutral pole switched simultaneously with phase poles.
M. Neutral Terminal: Solid and fully rated unless otherwise indicated.
N. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
O. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
P. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
    1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
    2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
    3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
    4. Accessible via rear access.
Q. Enclosures: General-purpose NEMA 250, Type 12, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.
R. Switchboard, ATS and MCC shall be furnished by the same manufacturer.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Allen Bradley.
    2. Cutler Hammer.
    3. General Electric Company.
    4. Square-D.
B. Comply with Level 1 equipment according to NFPA 110.
C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
    1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
    2. Switch Action: Double throw; mechanically held in both directions.
    3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
    4. Conductor Connectors: Suitable for use with conductor material and sizes.
    5. Material: Hard-drawn copper, 98 percent conductivity.
    6. Main and Neutral Lugs: Compression type.
    7. Ground bar.
    8. Connectors shall be marked for conductor size and type according to UL 1008.
D. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.
    1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
    2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

3. Fully automatic break-before-make operation with center off position.
4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.

E. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

F. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

G. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

H. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.

I. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

J. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
   a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
   b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates

exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
b. Push-button programming control with digital display of settings.
c. Integral battery operation of time switch when normal control power is unavailable.

K. Large-Motor-Load Power Transfer:

1. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
2. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

2.3 TRANSFER SWITCH ACCESSORIES

A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
   a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
   b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
   c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
   d. Transition: Provide open-transition operation when transferring between power sources.
   e. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
   f. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
   g. Manual Control: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less. Operating handles shall be externally operated.

h. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.
i. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
j. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

B. Remote Annunciator and Control System:
1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Include the following functions for indicated transfer switches:
a. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
b. Indication of switch position.
c. Indication of switch in test mode.
d. Indication of failure of digital communication link.
e. Key-switch or user-code access to control functions of panel.
f. Control of switch-test initiation.
g. Control of switch operation in either direction.
3. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically shall revert to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
4. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
a. Controls and indicating lights grouped together for each transfer switch.
b. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
c. Digital Communication Capability: Matched to that of transfer switches supervised.
d. Mounting: Flush, modular, steel cabinet unless otherwise indicated.

2.4 OUTPUT SIGNALS

A. The transfer switch shall have the following signals routed to the station control system (hardwired I/O):
1. Utility Power Available.
2. ATS in normal position.
3. ATS in emergency position.
4. ATS in test mode.
5. ATS ready to load.
6. Remote start and stop routed to generator.
7. Ability to accept ready to load signal from generator.

B. Equipment shall be provided with an unmanaged Ethernet switch connected to the station control system. The above data shall be communicated over Modbus TCP/IP.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and

voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.
   1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
      a. Overvoltage.
      b. Undervoltage.
      c. Loss of supply voltage.
      d. Reduction of supply voltage.
      e. Alternative supply voltage or frequency is at minimum acceptable values.
      f. Temperature rise.
      g. Dielectric voltage-withstand; before and after short-circuit test.
      h. Overload.
      i. Contact opening.
      j. Endurance.
      k. Short circuit.
      l. Short-time current capability.
      m. Receptacle withstand capability.
      n. Insulating base and supports damage.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
B. Identify components according to Section 260553 "Identification for Electrical Systems."
C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
D. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, motor controls, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
   1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
F. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.
G. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. After installing equipment, test for compliance with requirements according to NETA ATS.
   2. Visual and Mechanical Inspection:
      a. Compare equipment nameplate data with Drawings and Specifications.
      b. Inspect physical and mechanical condition.
      c. Inspect anchorage, alignment, grounding, and required clearances.
      d. Verify that the unit is clean.
      e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
      f. Verify that manual transfer warnings are attached and visible.
      g. Verify tightness of all control connections.
      h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
         1) Use of low-resistance ohmmeter.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
      i. Perform manual transfer operation.
      j. Verify positive mechanical interlocking between normal and alternate sources.
      k. Perform visual and mechanical inspection of surge arresters.
      l. Inspect control power transformers.
         1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
         2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
         3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
   3. Electrical Tests:
      a. Perform insulation-resistance tests on all control wiring with respect to ground.
      b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
      c. Verify settings and operation of control devices.
      d. Calibrate and set all relays and timers.
      e. Verify phase rotation, phasing, and synchronized operation.
      f. Perform automatic transfer tests.
      g. Verify correct operation and timing of the following functions:
         1) Normal source voltage-sensing and frequency-sensing relays.
         2) Engine start sequence.
         3) Time delay on transfer.
         4) Alternative source voltage-sensing and frequency-sensing relays.
         5) Automatic transfer operation.
         6) Interlocks and limit switch function.
         7) Time delay and retransfer on normal power restoration.
         8) Engine cool-down and shutdown feature.
   4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use

test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
   a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
   g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
   a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.
D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
E. Transfer switches will be considered defective if they do not pass tests and inspections.
F. Remove and replace malfunctioning units and retest as specified above.
G. Prepare test and inspection reports.
H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
   1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
   3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where

ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

C. Coordinate this training with that for generator equipment.

**END OF SECTION 26 36 00**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes lightning protection system for the following:
  1. Pump Station.
  2. Pump Station Generator Building.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
- B. Shop Drawings:
  1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
  2. Include raceway locations needed for the installation of conductors.
  3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
  4. Include roof attachment details, coordinated with roof installation.
  5. Calculations required by NFPA 780 for bonding of metal bodies.

1.4 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Lightning protection cabling attachments to roofing systems and accessories.
  2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
  3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.
- B. Qualification Data: For Installer.
- C. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For lightning protection system to include in maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
     a. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.
- B. Completion Certificate:
  1. UL Master Label Certificate.

1.6 QUALITY ASSURANCE
- A. Installer Qualifications: UL-listed installer, category OWAY.
- B. Lightning Qualified Company: The Company hired to perform the lightning protection system shall have a minimum of 5 years of experience in the design and manufacture of

UL listed lightning protection equipment. The company shall be licensed to perform Professional Engineering in the State of Illinois.

C. All submitted documents shall be signed and sealed by a registered professional engineer in the State of Illinois.

1.7 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advanced Lightning Technology, Ltd.
   2. National Lightning Protection.
   3. Thompson Lightning Protection, Inc.

### 2.2 PERFORMANCE REQUIREMENTS

A. UL Lightning Protection Standard: Comply with UL 96A requirements for Class I buildings.

B. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

### 2.3 MATERIALS

A. General:
   1. All materials furnished for the lightning protection system shall bear the inspection label of UL.

B. Air Terminals:
   1. Copper unless otherwise indicated.
   2. Be a minimum of 10 inches long.
   3. Rounded tip.
   4. Integral base support.
   5. Not exceed intervals of 20’-0” along ridges and along the perimeter of flat or gently sloping roofs that have a pitch less than 3:12. Air terminals shall be located within two feet of roof edges and outside corners of protected areas.
   6. Air terminal bases shall be securely fastened to the structure in accordance with the specified standards including the use of adhesive that is compatible with the surface it is to be used on or stainless steel fasteners.

C. Air Terminal Bracing:
   1. Copper.
   2. 1/4-inch diameter rod.

D. Class 1 Main Conductors:
   1. Stranded Copper: 57,400 circular mils in diameter.
   2. There shall be two way horizontal or downward path from each air terminal to connection with the ground system.

E. Down Conductors:

1. Stranded Copper: 57,400 circular mils in diameter.
2. Down conductors shall be spaced at intervals averaging not more than 100 feet around the perimeter of the structure. In no case shall a structure have fewer than two down conductors. Where down conductors are installed exposed on the exterior of a structure and are subject to physical damage or displacement, guards shall be used to protect the conductor a minimum of six feet above grade. Metallic guards shall be bonded at each end.
3. Roof penetrations required for down conductors shall be made using thru-roof assemblies with solid riser bars and appropriate roof flashing. Conductors shall not pass directly through the roof.

F. Ground Loop Conductor: Stranded copper.
G. Ground Rods:
   1. Material: Solid copper.
   2. Diameter: 5/8 inch.
   3. Rods shall be a minimum of 120 inches long.
H. Conductor Splices and Connectors: Shall be exothermic welds.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install lightning protection components and systems according to NFPA 780.
B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.
C. Conductors shall be free of excessive splices.
D. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed systems in NFPA 780.
   1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
   2. Install conduit where necessary to comply with conductor concealment requirements.
   3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
E. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

### 3.2 CONNECTIONS

A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds.
B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: exothermic weld.
C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

## 3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.
C. Copper materials shall not be mounted on aluminum surfaces including Galvalume, galvanized steel and zinc; this includes these materials that have been painted.

## 3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Perform inspections as required to obtain a UL Master Label for system.
B. Prepare test and inspection reports and certificates.

**END OF SECTION 26 41 13**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Requirements:
  1. Section 262413 "Switchboards" for factory-installed SPDs.

1.3 DEFINITIONS
- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS
- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY
- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

1.8 BASIS OF PAYMENT
- A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NFPA 70.
C. Comply with UL 1449.
D. MCOV of the SPD shall be the nominal system voltage.

### 2.2 SERVICE ENTRANCE SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allen Bradley.
   2. Cutler Hammer.
   3. General Electric Company.
   4. Square-D.
B. SPDs: Comply with UL 1449, Type 1.
   1. SPDs with the following features and accessories:
      a. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
      b. Indicator light display for protection status.
      c. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status from the SCADA system. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
      d. Surge counter.
      e. Indicator light display when any value of less than 50% suppression protection is available from the SPD.
C. Comply with UL 1283.
D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: 1200 V for 480Y/277 V.
   2. Line to Ground: 1200 V for 480Y/277 V.
   3. Line to Line: 2000 V for 480Y/277 V.
F. SCCR: Equal or exceed 100 kA.
G. Inominal Rating: 20 kA.

### 2.3 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

### 2.4 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Comply with NECA 1.
B. Install a disconnect as required to comply with the UL listing of the SPD.
C. The SPD shall be located within 10 feet (cable distance) from the disconnect.
D. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
E. Use crimped connectors and splices only. Wire nuts are unacceptable.
F. Wiring:
    1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
    2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
    1. Compare equipment nameplate data for compliance with Drawings and Specifications.
    2. Inspect anchorage, alignment, grounding, and clearances.
    3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
B. An SPD will be considered defective if it does not pass tests and inspections.
C. Prepare test and inspection reports.

### 3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.
B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
C. Energize SPDs after power system has been energized, stabilized, and tested.

### 3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

**END OF SECTION 26 43 13**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 51 19 - LED INTERIOR LIGHTING**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the following types of LED luminaires:
   1. Highbay, nonlinear.
   2. Linear industrial.

B. Related Requirements:
   1. Section 260519 "Low-voltage Electrical Conductors and Cables" for wiring of lighting.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color Rendering Index.
C. Fixture: See "Luminaire."
D. IP: International Protection or Ingress Protection Rating.
E. LED: Light-emitting diode.
F. Lumen: Measured output of lamp and luminaire, or both.
G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.
   5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
   6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
      a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Luminaires.

2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
   a. Other luminaires.
   b. Air outlets and inlets.
   c. Speakers.
   d. Access panels.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.
C. Product Certificates: For each type of luminaire.
D. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: 3 of each type and rating installed. Furnish at least one of each type.
   2. Diffusers and Lenses: 3 of each type and rating installed. Furnish at least one of each type.
   3. Globes and Guards: 3 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
B. Provide luminaires from a single manufacturer for each luminaire type.
C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
B. Warranty Period: Five year(s) from date of Substantial Completion.

1.11 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F.
   1. Relative Humidity: Zero to 95 percent.
B. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage, and coating.
      c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. California Title 24 compliant.

2.3 HIGHBAY, NONLINEAR.

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell.

B. Nominal Operating Voltage: 120 V ac.

C. Lamp:
   1. Minimum 1000 lm.
   2. Minimum allowable efficacy of 80 lm/W.
   3. CRI of minimum 65. CCT of 4000 K.
   4. Rated lamp life of 35,000 hours to L70.
   5. Dimmable from 100 percent to 0 percent of maximum light output.
   6. Internal driver.
   7. User-Replaceable Lamps:
      a. Bulb shape complying with ANSI C78.79.
      b. Lamp base complying with ANSI C81.61.
   8. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

D. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear powder-coat painted finish.
   3. Universal mounting bracket.
   4. Integral junction box with conduit fittings.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:
   1. Prismatic acrylic.
   2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Glass: Annealed crystal glass unless otherwise indicated.
   4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

G. Standards:
   1. ENERGY STAR certified.

2. RoHS compliant.
3. UL Listing: Listed for damp location.

2.4 LINEAR INDUSTRIAL.

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cree.
   2. New Star.
   3. Williams.

B. Lamp:
   1. Minimum 5,000 lm.
   2. Minimum allowable efficacy of 80 lm/W.
   3. CRI of minimum 65. CCT of 4000 K.
   4. Rated lamp life of 35,000 hours to L70.
   5. Dimmable from 100 percent to 0 percent of maximum light output.
   6. Internal driver.
   7. User-Replaceable Lamps:
      a. Bulb shape complying with ANSI C78.79.
      b. Lamp base complying with ANSI C81.61.
   8. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

C. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear powder-coat painted finish.

D. Housing and Heat Sink Rating:
   1. Class 1, Division 2 Group D.
   2. NEMA 4X.
   3. IP 54.
   4. IP 66.
   5. CSA C22.2 No 137.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:
   1. Prismatic acrylic.
   2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Glass: Annealed crystal glass unless otherwise indicated.
   4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

G. With integral mounting provisions.

H. Standards:
   1. ENERGY STAR certified.
   2. RoHS compliant.

2.5 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Steel:
   1. ASTM A36/A36M for carbon structural steel.
   2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:
   1. 1. Manufacturer's standard grade.
   2. 2. Manufacturer's standard type, ASTM A240/240M.
D. Galvanized Steel: ASTM A653/A653M.
E. Aluminum: ASTM B209.

2.6 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.
D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.
B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
C. Install lamps in each luminaire.
D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
E. Flush-Mounted Luminaires:
   1. Secured to outlet box.
   2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
   3. Trim ring flush with finished surface.
F. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:
1. Ceiling Mount:
2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Engineer.

END OF SECTION 26 51 19

**DIVISION 26 – ELECTRICAL**
**SECTION 26 52 13 - EMERGENCY AND EXIT LIGHTING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Emergency lighting units.
  2. Exit signs.
  3. Luminaire supports.
- B. Related Requirements:
  1. Section 260519 "Low-voltage Electrical Conductors and Cables" for wiring of lighting.

1.3 DEFINITIONS
- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS
- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
  1. Include data on features, accessories, and finishes.
  2. Include physical description of the unit and dimensions.
  3. Battery and charger for light units.
  4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
  5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
     a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
  6. For custom luminaires, retain "Samples" Paragraph below for single-stage Samples, with a subordinate list if applicable. Retain "Samples for Initial Selection" and "Samples for Verification" paragraphs for two-stage Samples.
- B. Product Schedule:
  1. For emergency lighting units. Use same designations indicated on Drawings.
  2. For exit signs. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Luminaires.
  2. Suspended ceiling components.

3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment will be attached.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling including the following:
    a. Other luminaires.
    b. Air outlets and inlets.
    c. Access panels.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.
C. Product Certificates: For each type of luminaire.
D. Product Test Reports: For each luminaire for tests performed by a qualified testing agency.
E. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: Furnish at least two spares of each type.
2. Luminaire-mounted, emergency battery pack: Furnish at least two spares of each type.
3. Diffusers and Lenses: Furnish at least four spares of each type.
4. Globes and Guards: Furnish at least five spares of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
B. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two year(s) from date of Substantial Completion.
B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.
2. Warranty Period for Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

1.11 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

1. Emergency Connection: Operate lamps continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    a. Ambient Temperature: Less than 50 deg F or exceeding 132 deg F, with an average value exceeding 95 deg F over a 24-hour period.
    b. Humidity: More than 95 percent (condensing).
    c. Both the wet well and dry well locations are considered hazardous and shall be explosion proof to meet Class I, Division 2, Group D location criteria per NFPA 820.
4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
5. Battery: Sealed, maintenance-free, nickel-cadmium type.
6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
8. The batteries for all exit signs and emergency lighting units shall be sized to operate for a minimum of 90 minutes.

2.2 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Luminaires:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Lithonia Lighting; Acuity Brands Lighting, Inc.
   b. LightAlarms
2. Emergency Luminaires: as indicated on Drawings, with the following additional features:
   a. Operating at nominal voltage of 120 V ac.
   b. Internal emergency power unit.
   c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.

C. Emergency Lighting Unit:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Lightalarms.
2. Emergency Lighting Unit: as indicated on Drawings.
3. Operating at nominal voltage of 120 V ac.
4. Wall with universal junction box adaptor.
5. UV stable thermoplastic housing, rated for damp locations.
6. Two LED lamp heads.
7. Internal emergency power unit.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Lutron.
   b. Signtex.
2. Operating at nominal voltage of 120 V ac.
3. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
4. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.4 MATERIALS

A. Metal Parts:
1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:
1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:
1. Prismatic acrylic.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:
   1. Extruded aluminum housing and heat sink.
   2. Clear finish.
E. Conduit: Rigid galvanized steel, minimum 3/4 inch in diameter.

2.5 METAL FINISHES
A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS
A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

**PART 3 - EXECUTION**

3.1 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Comply with NECA 1.
B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
C. Install lamps in each luminaire.
D. Supports:
   1. Sized and rated for luminaire and emergency power unit weight.
   2. Able to maintain luminaire position when testing emergency power unit.
   3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
E. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.
F. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
   3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
   4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service:
   1. Charge emergency power units and batteries a minimum of one hour and depress switch to conduct short-duration test.
   2. Charge emergency power units and batteries a minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
   1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.
      a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   2. Conduct short-duration tests on all emergency lighting.

**END OF SECTION 26 52 13**

**DIVISION 26 – ELECTRICAL**
**SECTION 26 56 19 – LED EXTERIOR LIGHTING**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
  2. Luminaire supports.
  3. Luminaire-mounted photoelectric relays.

1.3 DEFINITIONS
- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS
- A. Product Data: For each type of luminaire.
  1. Arrange in order of luminaire designation.
  2. Include data on features, accessories, and finishes.
  3. Include physical description and dimensions of luminaire.
  4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
     a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
  6. Wiring diagrams for power, control, and signal wiring.
  7. Photoelectric relays.
  8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
  1. Include plans, elevations, sections, and mounting and attachment details.
  2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For luminaire supports.
  1. Include design calculations for luminaire supports.

1.5 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Structural members to which luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of the following:
1. Luminaire.
2. Photoelectric relay.

D. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

E. Source quality-control reports.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: 3 of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: 3 of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: 3 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: 3 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including luminaire support components.
      b. Faulty operation of luminaires and accessories.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 year(s) from date of Substantial Completion.

1.12 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

**PART 2 - PRODUCTS**

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
D. UL Compliance: Comply with UL 1598.
E. Lamp base complying with ANSI C81.61.
F. Bulb shape complying with ANSI C79.1.
G. CRI of minimum of 65. CCT of 4000 K.
H. L70 lamp life of 35,000 hours.
I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
J. Internal driver.
K. Nominal Operating Voltage: 120 V ac.
L. Lamp Rating: Lamp marked for outdoor use.
M. Source Limitations: Obtain luminaires from single source from a single manufacturer.
N. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Eaton.
   2. GE Lighting Solutions.
   3. Lithonia Lighting; Acuity Brands Lighting, Inc.
   4. Siemens Industry, Inc., Building Technologies Division.
B. Comply with UL 773 or UL 773A.
C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
   1. Relay with locking-type receptacle shall comply with ANSI C136.10.
   2. Adjustable window slide for adjusting on-off set points.

2.3 LUMINAIRE TYPES

A. Area and Site:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cree.
      b. Williams.
   2. Luminaire Shape: Round.
   3. Mounting: Building.
   4. Luminaire-Mounting Height: 10’-0”.
   5. Distribution: Type III.
   6. Diffusers and Globes: Prismatic acrylic.

2.4 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.
B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.
C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
D. Diffusers and Globes:
   1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Glass: Annealed crystal glass unless otherwise indicated.
   3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
G. Housings:
   1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
   2. Provide filter/breather for enclosed luminaires.
H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage and coating.
      c. CCT and CRI for all luminaires.

2.5 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
   2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
   3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
   4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
   2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
C. Examine walls, roofs, for suitable conditions where luminaires will be installed.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.
B. Install lamps in each luminaire.
C. Fasten luminaire to structural support.
D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Support luminaires without causing deflection of finished surface.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

H. Coordinate layout and installation of luminaires with other construction.

I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:
1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
a. IES LM-5.
b. IES LM-50.
c. IES LM-52.
d. IES LM-64.
e. IES LM-72.
2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to

suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Engineer.

**END OF SECTION 26 56 19**

**DIVISION 27 – COMMUNICATIONS**
**SECTION 27 05 53 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Color and legend requirements for labels and signs.
  2. Labels.
  3. Bands and tubes.
  4. Tapes.
  5. Signs.
  6. Cable ties.
  7. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for communications identification products.
- B. Identification Schedule:
  1. Outlets: Scaled drawings indicating location and proposed designation.
  2. Backbone Cabling: Riser diagram showing each communications room, backbone cable, and proposed backbone cable designation.
  3. Racks: Scaled drawings indicating location and proposed designation.
  4. Patch Panels: Enlarged scaled drawings showing rack row, number, and proposed designations.

1.4 BASIS OF PAYMENT
- A. The work shall be paid at the contract lump sum price for **PUMP STATION ELECTRICAL WORK** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70 and TIA 606-B.
- B. Comply with ANSI Z535.4 for safety signs and labels.
- C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
  1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Equipment Identification Labels:
  1. Black letters on a white field.

## 2.3 LABELS

A. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Brady Corporation.
      b. Marking Services, Inc.
      c. Panduit Corp.
   2. Minimum Nominal Size:
      a. 1-1/2 by 6 inches for raceway and conductors.
      b. 3-1/2 by 5 inches for equipment.
      c. As required by authorities having jurisdiction.

## 2.4 UNDERGROUND-LINE WARNING TAPE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Brady Corporation.
   2. Marking Services, Inc.

B. Tape:
   1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground communications utility lines.
   2. Printing on tape shall be permanent and shall not be damaged by burial operations.
   3. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

C. Color and Printing:
   1. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, and ANSI Z535.4.
   2. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL-FIBER CABLE".

D. Tag: :
   1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   2. Width: 3 inches.
   3. Overall Thickness: 8 mils.
   4. Foil Core Thickness: 0.35 mil.
   5. Weight: 34 lb/1000 sq. ft..
   6. Tensile according to ASTM D882: 300 lbf and 12,500 psi.

## 2.5 SIGNS

A. Laminated-Acrylic or Melamine-Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. Marking Services, Inc.
2. Engraved legend.
3. Thickness:
   a. For signs up to 20 sq. in., minimum 1/16 inch thick.
   b. For signs larger than 20 sq. in., 1/8 inch thick.
   c. Engraved legend with white letters on a dark gray background.
   d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.6 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Marking Services, Inc.
   2. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength at 73 deg F according to ASTM D638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.
   4. Color: Black, except where used for color-coding.

## 2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

## 3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop

Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.
C. Verify identity of each item before installing identification products.
D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
E. Apply identification devices to surfaces that require finish after completing finish work.
F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.
G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
H. Self-Adhesive Labels:
    1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
    2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
I. Snap-Around, Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
J. Underground-Line Warning Tape:
    1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
    2. Install underground-line warning tape for direct-buried cables and cables in raceways.
K. Cable Ties: General purpose, except as listed below:
    1. Outdoors: UV-stabilized nylon.
    2. In Spaces Handling Environmental Air: Plenum rated.

## 3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.
C. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.
    1. System legends shall be as follows:
        a. Telecommunications.
D. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, composed of the following, in the order listed:
    1. Wiring closet designation.
    2. Colon.
    3. Faceplate number.
E. Equipment Room Labeling:
    1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.

2. Patch Panels: Label individual rows in each rack, starting at top and working down, with self-adhesive labels.
3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed:
    a. Room number being served.
    b. Colon.
    c. Faceplate number.

F. Backbone Cables: Label each cable with a self-adhesive wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.

G. Horizontal Cables: Label each cable with a self-adhesive wraparound label indicating the following, in the order listed:
1. Room number.
2. Colon.
3. Faceplate number.

H. Locations of Underground Lines: Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.

I. Instructional Signs: Self-adhesive labels.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Self-adhesive labels.
1. Apply to exterior of door, cover, or other access.

K. Equipment Identification Labels:
1. Indoor Equipment: Self-adhesive label.
2. Outdoor Equipment: Laminated-acrylic or melamine-plastic sign.
3. Equipment to Be Labeled:
    a. Communications cabinets.
    b. Uninterruptible power supplies.
    c. Fire-alarm and suppression equipment.
    d. Egress points.

**END OF SECTION 27 05 53**

**DIVISION 28 - ELECTRONIC SAFETY AND SECURITY**
**DIVISION 28 31 00 - INTRUSION DETECTION**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Intrusion detection with communication links to perform monitoring, alarm, and control functions.
  2. Integration of other electronic and electrical systems and equipment.
- B. Related Sections:
  1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for power cabling between master control units and field-mounted devices and control units.

1.3 DEFINITIONS
- A. PIR: Passive infrared.
- B. RFI: Radio-frequency interference.
- C. UPS: Uninterruptible power supply.
- D. Control Unit: System component that monitors inputs and controls outputs through various circuits.
- E. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.
- F. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.
- G. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.
- H. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.
- I. Zone. A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

1.4 ACTION SUBMITTALS
- A. Product Data: Components for sensing, detecting, systems integration, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
  1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify programmable logic controllers networks and control interface devices and media to be used. Describe characteristics of network and other data communication lines.
     a. Indicate methods used to achieve systems integration.

b. Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
c. Describe characteristics of network and other data communication lines.
d. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.

2. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection and for systems integration. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.
3. UPS: Sizing calculations.
4. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building. Include room layout for master control-unit console, terminal cabinet, racks, and UPS.
5. Master Control-Unit Console Layout: Show required artwork and device identification.
6. Device Address List: Coordinate with final system programming.
7. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
8. Details of surge-protection devices and their installation.
9. Sensor detection patterns and adjustment ranges.

C. Design Data: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.
D. Samples for Initial Selection: For units with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For intrusion detection systems integrator.
B. Field quality-control reports.
1. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
C. Product Warranty: Sample of special warranty.
D. Field Test Reports: Test plan and report defining all tests required to ensure that system meets technical, operational, and performance specifications within 60 days of date of Contract award.
E. Evaluation Reports: Examination reports documenting inspections of substrates, areas, and conditions.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Data for each type of product, including features and operating sequences, both automatic and manual.
2. Master control-unit hardware and software data.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Intrusion Detection Devices: Furnish quantity equal to five percent of the number of units of each type installed, but no fewer than one of each type.

2. Fuses: Three of each kind and size.
3. Tool Kit: Provide six sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.
4. Security Fasteners: Furnish no fewer than 1 box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:
1. An employer of workers, at least one of whom is a Certified Alarm Technician, Level 1.
2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
3. Layout Responsibility: Preparation of Shop Drawings, cabling administration Drawings, and field testing program development by an RCDD.
4. Installation Supervision: Installation shall be under the direct supervision of Level 2 Commercial Installer, who shall be present at all times when Work of this Section is performed at Project site.
5. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Intrusion Detection Systems Integrator Qualifications: An experienced intrusion detection equipment supplier and Installer who has completed systems integration work for installations similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
1. At least one of whom is a Certified Systems Integrator.

C. Testing Agency Qualifications: Certified by BICSI.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.9 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Altitude: Sea level to 4000 feet.
2. Master Control Unit: Rated for continuous operation in an ambient of 50 to 132 deg F and a relative humidity of 20 to 80 percent, noncondensing.
3. Interior, Controlled Environment: System components, except master control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 50 to 132 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings shall be rated, listed, and installed according to NFPA 70.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

1.11 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **INTRUSION DETECTION PANEL** which shall be payment in full for the work described herein.

**PART 2 - PRODUCTS**

2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Description: Hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.

B. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
   1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
   2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
   3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or control unit.

C. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.

D. System Control: Master control unit shall directly monitor intrusion detection devices, perimeter detection units, and connecting wiring in a multiplexed distributed control system or as part of a network.

E. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.

F. Operator Commands:
   1. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
   2. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
   3. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
   4. Protected Zone Test: Initiate operational test of a specific protected zone.
   5. System Test: Initiate system-wide operational test.
   6. Print reports.

G. Timed Control at Master Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.

H. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:
   1. Switch selected lights.
   2. Shift elevator control to a different mode.
   3. Open a signal path between certain intercommunication stations.
   4. Shift sound system to "listening mode" and open a signal path to certain system speakers.

I. Printed Record of Events: Print a record of alarm, supervisory, and trouble events on system printer. Sort and report by protected zone, device, and function. When master control unit receives a signal, print a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with the same information concerning device, location, date, and time. Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.

J. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.

K. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

L. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

M. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.2 SYSTEM COMPONENT REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.

C. FM Global Compliance: FM-Approved and -labeled intrusion detection devices and equipment.

D. Comply with NFPA 70.

E. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:

1. Fire alarm system specified in Section 284621.11 "Addressable Fire-Alarm Systems."
2. Video surveillance system specified in Section 282000 "Video Surveillance."

F. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.

G. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.

H. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.

I. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.

J. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master control unit.

K. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master control unit as an alarm signal.

L. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.

M. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master control unit for calibration, sensitivity, and alarm condition.

2.3 ENCLOSURES

A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.

B. Interior Electronics: NEMA 250, Type 12.

C. Exterior Electronics: NEMA 250, Type 4X, stainless steel.

D. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

2.4 SECURE AND ACCESS DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Honeywell International Inc.

B. Key-Operated Switch: Change protected zone between secure and access conditions.
1. The key operated switch shall be located on the outside of the south electrical room door.
2. The security override switch (unoccupied–occupied) shall be weatherproof, coordinated with the City of Lake Forest and be removable from either position.
3. The switch shall contain a LED status light to indicate open or closed position and include a tamper pushbutton to be held open by the cover plate and spring closed if the cover is removed.
4. The override switch shall have two contacts, one contact for shutting the door switches and one contact for connection to the SCADA panel.
5. All door switches and tamper switches shall be wired in parallel.

2.5 DOOR SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Honeywell International Inc.

B. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.
1. The switch contacts shall be closed when the door is open and open when the door is closed.

C. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.
1. Hazardous locations shall have explosion proof rated switches
2. Non-hazardous locations shall be non-explosion proof rated

D. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounted magnet and floor-mounted switch unit.

E. Remote Test: Simulate movement of actuating magnet from master control unit.

2.6 MASTER CONTROL UNIT

A. Alarmed components are to be monitored by the Pump Station 38 SCADA panel.

B. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.
   1. Addressable initiation devices that communicate device identity and status.

C. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.

D. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.

E. UPS: UPS shall be sized to provide a minimum of 24 hours of master control-unit operation.

F. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch high. Identify, with permanent labels, individual components and modules within cabinets.

G. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over privately owned fiber optic lines to the City of Lake Forest's command center.

2.7 AUDIBLE AND VISUAL ALARM DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Honeywell International Inc.

B. Bell: 10 inches in diameter, rated to produce a minimum sound output of 84 dB at 10 feet from master control unit.
   1. Enclosure: Weather-resistant steel box equipped with tamper switches on cover and on back of box.

C. Klaxon Weatherproof Motor-Driven Hooter: UL listed, rated to produce a minimum sound output of 120 dB at 3 feet, plus or minus 3 dB, at a frequency of 470 Hz. Rated for intermittent use: two minutes on and five minutes off.
   1. Designed for use in industrial areas and in high-noise, severe-weather marine environments.
   2. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.

D. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.
   1. Light Output: 115 cd, minimum.
   2. Flash Rate: 60 per minute.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.
   1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
   2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.
E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.
F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEM INTEGRATION

A. Integrate intrusion detection system with the following systems and equipment:
   1. Electronic door hardware.
   2. Fire-alarm system.
   3. General Alarm (Gas or Fire)
   4. Pump Station Power Failure (Normal or Emergency Source)
   5. High Water Level on Pavement
   6. High Wet Well Water Level
   7. SCADA Alarm
   8. Low Wet Well Water Level
   9. Pump Alarm
   10. AEGIS Battery Low (integral to AEGIS)
   11. AEGIS Heartbeat (integral to AEGIS)

3.3 SYSTEM INSTALLATION

A. Comply with UL 681 and NFPA 731.
B. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
D. Connecting to Existing Equipment: Verify that existing perimeter security system is operational before making changes or connections.
   1. Connect new equipment to existing control panel in existing part of the building.
   2. Connect new equipment to existing monitoring equipment at the Supervising Station.
   3. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
E. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in stainless-steel materials.

3.4 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceways according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables," except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Wires and Cables:
   1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.
   2. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
   3. Data and Television Signal Transmission Cables: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

F. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 270553 "Identification for Communications Systems."

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Section 270553 "Identification for Communications Systems."

B. Install instructions frame in a location visible from master control unit.

3.6 GROUNDING

A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.

B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.

D. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Section 270526 "Grounding and Bonding for Communications Systems."

3.7 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
   1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
C. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."
   1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
   2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."
D. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."
E. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

**END OF SECTION 28 31 00**

**SECTION 28 - ELECTRONIC SAFETY AND SECURITY**
**SECTION 28 46 21.11 - ADDRESSABLE FIRE-ALARM SYSTEMS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
- A. Section Includes:
  1. Fire-alarm control unit.
  2. Manual fire-alarm boxes.
  3. System smoke detectors.
  4. Air-sampling smoke detectors.
  5. Nonsystem smoke detectors.
  6. Heat detectors.
  7. Notification appliances.
  8. Device guards.
  9. Remote annunciator.
  10. Graphic annunciator.
  11. Addressable interface device.
  12. Digital alarm communicator transmitter.
  13. Network communications.
  14. Cables and conductors for fire-alarm systems.

1.3 DEFINITIONS
- A. FACP: Fire Alarm Control Panel.
- B. HLI: High Level Interface.
- C. NICET: National Institute for Certification in Engineering Technologies.
- D. VESDA: Very Early Smoke-Detection Apparatus.

1.4 ACTION SUBMITTALS
- A. Product Data: For each type of product, including furnished options and accessories.
  1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.
  1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
  2. Include plans, elevations, sections, details, and attachments to other work.
  3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  4. Detail assembly and support requirements.
  5. Include voltage drop calculations for notification-appliance circuits.
  6. Include battery-size calculations.
  7. Include input/output matrix.
  8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
  9. Include performance parameters and installation details for each detector.

10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    c. Locate detectors according to manufacturer's written recommendations.
    d. Show air-sampling detector pipe routing.
13. Include alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level IV minimum.
    c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
3. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.

4. Riser diagram.
5. Device addresses.
6. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
7. Record copy of site-specific software.
8. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
   a. Equipment tested.
   b. Frequency of testing of installed components.
   c. Frequency of inspection of installed components.
   d. Requirements and recommendations related to results of maintenance.
   e. Manufacturer's user training manuals.
9. Manufacturer's required maintenance related to system warranty requirements.
10. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
   2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
   3. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
   4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
   5. Keys and Tools: One extra set for access to locked or tamper proofed components.
   6. Audible and Visual Notification Appliances: One of each type installed.
   7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
   8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
   9. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.10 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
   1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.

2. Warranty Period: Five years from date of Substantial Completion.

1.12 BASIS OF PAYMENT

A. The work shall be paid at the contract lump sum price for **FIRE DETECTION PANEL** which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
   1. Manual stations.
   2. Heat detectors.
   3. Flame detectors.
   4. Smoke detectors.
   5. Combustible gas detectors.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances.
   2. Identify alarm and specific initiating device at fire-alarm control unit.
   3. Transmit an alarm signal to the remote alarm receiving station.
   4. Unlock electric door locks in designated egress paths.
   5. Release fire and smoke doors held open by magnetic door holders.
   6. Activate voice/alarm communication system.
   7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   8. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
   9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
   10. Activate preaction system.
   11. Activate emergency shutoffs for gas and fuel supplies.
   12. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
   1. Alert and Action signals of air-sampling detector system.
   2. Independent fire-detection and -suppression systems.
   3. User disabling of zones or individual devices.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
   1. Open circuits, shorts, and grounds in designated circuits.
   2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.

3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.

E. System Supervisory Signal Actions:
1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
4. Transmit system status to building management system.
5. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Fire-Lite Alarms, Inc.; a Honeywell International company.
2. Gamewell - FCI by Honeywell.
3. GE UTC Fire & Security; A United Technologies Company.
4. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.
c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
d. The FACP shall be listed for connection to a central-station signaling system service.
e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
f. Contain a backup battery system sized for 24 hours of operation
g. Be provided with a solid state, fully automatic charger, automatic transfer switch, and necessary control relays.
h. Be able to receive a non-latching normally open non-function contact (combustible gas monitor alarm relay). The contact closure shall activate the horn/strobes only so that the other fire detection system functions are not affected (resettable from Fire Alarm Panel and / or Combustible Gas systems).
i. Hardwired signals interfacing the FACP:
1) Gas Monitor Alarm Relay from Fire Alarm System
2) Alarm to AEGIS system
3) Signals to field strobes and horns
4) Signals from field pull stations

5) Trouble signal to station PLC
6) Alarm signal to station PLC

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, threeline(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

E. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, Class A.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.

F. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

G. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed lead calcium.

L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fire-Lite Alarms, Inc.; a Honeywell International company.
2. Gamewell - FCI by Honeywell.
3. GE UTC Fire & Security; A United Technologies Company.
4. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit. Stations requiring breaking of glass panel are unacceptable.
2. Station Reset: Key- or wrench-operated switch.
3. Fire Alarm boxes in hazardous classified areas shall be explosion proof rated.
4. Shall be located at every exit door in each area and at each change in elevation.

2.5 SYSTEM SMOKE DETECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fire-Lite Alarms, Inc.; a Honeywell International company.
2. Gamewell - FCI by Honeywell.
3. GE UTC Fire & Security; A United Technologies Company.
4. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
a. Multiple levels of detection sensitivity for each sensor.
b. Sensitivity levels based on time of day.
6. Red smoke detectors shall be located in the electrical room only.
7. Smoke detectors shall be photoelectric type equipped with an infrared detector light source.

C. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

2.6 HEAT DETECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Fire-Lite Alarms, Inc.; a Honeywell International company.
   2. Gamewell - FCI by Honeywell.
   3. GE UTC Fire & Security; A United Technologies Company.
   4. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for Heat Detectors: Comply with UL 521.
   1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature.
   1. Mounting: Adapter plate for outlet box mounting.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
   3. Red heat detectors shall be located in areas that have hazardous classification ratings.
   4. Heat detectors shall be combinational fixed temperature and rate of rise units 135°F fixed temperature setting.

2.7 NOTIFICATION APPLIANCES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. GE UTC Fire & Security; A United Technologies Company.
   2. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

F. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
   1. Rated Light Output:
      a. 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

G. Tone Notification Appliances:
1. Comply with UL 1480.
2. High-Range Units: Rated 2 to 15 W.
3. Mounting: surface mounted and bidirectional.
4. Matching Transformers: Tap range matched to acoustical environment of speaker location.

H. Exit Marking Audible Notification Appliance:
1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
2. Provide exit marking audible notification appliances at the entrance to all building exits.
3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.8 ADDRESSABLE INTERFACE DEVICE

A. General:
1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Control Module:
1. Operate notification devices.

2.9 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway for connection to AEGIS system.

2.10 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:
1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
2. Smooth ceiling spacing shall not exceed 30 feet.
3. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
4. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
5. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.

H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

I. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

J. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

2.11 PATHWAYS

A. Pathways shall be installed to conform with 260533 “Raceways and Boxes for Electrical Systems”.

B. Exposed conduit shall be painted red enamel.

2.12 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
3. Data communication circuits for connection to AEGIS system.

2.13 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

2.14 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

2.15 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by the Design Engineer.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.
    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

2.16 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

2.17 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

2.18 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

**END OF SECTION 28 46 21.11**

**DIVISION 33 - UTILITIES**

**SECTION 33 40 10 – INTERIOR PIPE AND APPURTENANCES**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED**

A. Provide pipe and fittings as specified on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Provide labor, materials, tools and equipment as necessary to install all fittings and accessories required for the completion of all pipelines covered in this Section.

C. The sizes, types and classes of various pipelines shall be as shown on the Drawings.

**1.2 RELATED WORK**

A. Work under this Section is also subject to the requirements specified under Division 1 of these Contract Documents.

B. Section 09 91 00: Painting

C. Section 33 40 20: Pipe Hangers and Supports

D. Section 33 40 30: Pipe Specialties

E. Section 43 01 50: General Mechanical Provisions

F. Section 43 20 10: Valves and Appurtenances

**1.3 REFERENCES**

A. Copper tubing and materials shall conform to AWWA Standard C800, and as specified herein.

B. PVC Pipe and Fittings shall conform to the latest editions of the following:

1. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100 mm through 300 mm) for Water Distribution.

2. AWWA C905 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350 mm through 1,200 mm) for Water Transmission and Distribution.

3. AWWA C907 – Polyvinyl Chloride (PVC) Pressure Fittings for Water, 4 in. through 8 in (100 mm through 200 mm)/

4. AWWA C909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. through 24 in. (100 mm through 600 mm), for Water Distribution.

5. ASTM D1785 – Poly (Vinyl-Chloride) (PVC) and Chlorinated Poly (Vinyl-Chloride) (CPVC) Plastic Pipe, Schedules 40, 80 and 120.

6. ASTM D2241 – Poly(Vinyl-Chloride) (PVC) Pressure-Rated Pipe (SDR PR Series).

7. ASTM D2464 – Threaded Poly (Vinyl-Chloride) (PVC) and Chlorinated Poly (Vinyl-Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

8. ASTM D2466 – Poly (Vinyl-Chloride) (PVC) and Chlorinated Poly (Vinyl-Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

9. ASTM D2467 – Poly (Vinyl-Chloride) (PVC) and Chlorinated Poly (Vinyl-Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

10. ASTM D2564 – Poly(Vinyl-Chloride) (PVC) Solvent Cements.

11. ASTM D2665 – Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

12. ASTM D2672 - Joints for Iron Pipe Size (IPS) Poly(Vinyl Chloride) (PVC) Pipe Using Solvent Cement

13. ASTM D3034 – Type PSM Poly (Vinyl-Chloride) (PVC) Sewer Pipe and Fittings.

14. ASTM D3139 – Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.

15. ASTM F438 – Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40

16. ASTM F439 – Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

17. ASTM F477 – Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

18. ASTM F679 – Poly (Vinyl-Chloride) (PVC) Large-Diameter Plastic Gravity Sewer

Pipe and Fittings.

C. Ductile Iron Pipe and Fittings shall conform to the latest editions of the following:

1. AWWA C104(ANSI A21.4) - Cement-Mortar Lining for Ductile-Iron Pipe and Fitting for Water.

2. AWWA C105(ANSI A21.5) - Polyethylene Encasement for Ductile-Iron Pipe systems.

3. AWWA C110(ANSI A21.10) - Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. For Water and Other Liquids.

4. AWWA C111(ANSI A21.11) - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C115(ANSI A21.15) - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

6. AWWA C150(ANSI A21.50) - Thickness Design of Ductile-Iron Pipe.

7. AWWA C151(ANSI A21.51) - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.

8. AWWA C153(ANSI A21.53) - Ductile-Iron Compact Fittings, 3 In. Through 24 In. and 54 In. Through 64 In., for Water Service.

9. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.

10. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.

11. AWWA C800 - Underground Service Line Valves and Fittings.

12. ANSI B18.2.1 - Square and Hex Bolts and Screws Inch Series, Including Hex Cap Screws and Lag Screws.

13. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.

14. ANSI B18.2.2, Square and Hex Nuts.

15. ASTM A48, Gray Iron Castings.

**1.4 QUALITY CONTROL**

D. All materials furnished shall be from an established and reputable manufacturer or supplier with at least 5 years of experience.

E. All pipe and appurtenances shall be new and of first class materials and construction. They shall be guaranteed to perform the services required and shall conform to the Special Provisions herein.

F. Shop Testing: All pipe and fittings shall be inspected and tested at the manufacturing facility as required by the Standard Specifications to which the material is manufactured. Certified copies of test results for each lot of pipe furnished shall be submitted to the ENGINEER by the CONTRACTOR for approval before the pipe is shipped. The pipe shall be subject to inspection by the ENGINEER at the point of manufacture.

## 1.5 SUBMITTALS

A. The required number of copies of shop drawings shall be provided in accordance with Division 1 of these Special Provisions.

B. Completely detailed working drawings shall be submitted by the CONTRACTOR for approval. Such drawings shall show the piping layouts and contain schedules of all pipe, fittings, valves, expansion joints, flexible couplings, anchors, hangers and supports, and other appurtenances. When any of the work is of special design, such work shall be shown in large detail and shall be completely described and dimensioned. Where indicated by the ENGINEER, each pipe section shall be marked with an identification number painted on the exterior of the pipe. If major damage should occur, the ENGINEER reserves the right to refuse the pipe or fitting, and the CONTRACTOR shall promptly replace the same with undamaged material at no additional cost to the OWNER.

C. The CONTRACTOR must give notice in writing to the ENGINEER, sufficiently in advance of his intention to purchase or place a special order for any pipe required to be installed under this contract. Fully dimensioned drawings and/or manufacturers catalog cut sheets are to be submitted for review.

D. The CONTRACTOR must submit to the ENGINEER certified copies of all test reports for tests conducted on the pipe by the manufacturer when requested by the ENGINEER.

E. CONTRACTOR or manufacturer shall certify that all welders have been tested and are maintain current qualification in accordance with ANSI/ASME Boiler and Pressure Vessel Code Section IX, or ANSI/AWS B2.1, Standard for Welding Procedure and Performance Qualification.

F. Certification of Design.

G. Technical data on coatings and linings as well as a description of application method.

H. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

## 1.6 STORAGE AND HANDLING

A. CONTRACTOR shall properly store pipes and fittings and use sufficient care during installation to preclude damage to factory painted surfaces. In the event minor damage should occur, the pipe or fitting shall be repaired following manufacturer's procedures. If major damage should occur the ENGINEER reserves the right to refuse the pipe or fitting and the CONTRACTOR shall promptly replace the same with undamaged material at no additional cost to the OWNER.

## 1.7 BASIS OF PAYMENT

A. The work under shall be paid as part of the Contract lump sum price for PUMP STATION MECHANICAL WORK which shall be payment in full for the work described herein.

# PART 2 - PRODUCTS

## 2.1 PVC PIPE AND FITTINGS

A. Pipe

1. PVC pipe and fittings for non-buried use, unless otherwise specified, shall be Schedule 40, 80 or 120 PVC pipe meeting the requirements of ASTM D1784 and ASTM D1785. Fittings shall be of the solvent welded socket type meeting the requirements of ASTM D2464, ASTM D2466, and ASTM D2467. Use compounds qualifying for a rating of 4000 psi for water at 73.4 degrees F.

## 2.4 DUCTILE IRON PIPE AND FITTINGS

A. Pipe

1. All ductile iron pipe shall be designed and manufactured in accordance with AWWA C150/ANSI A21.50 and AWWA C151/ANSI A21.51.

2. In addition to external load, all pipe and fittings shall be designed for collapse vacuum pressure of -14.7 psi with a factor of safety of 2.0.

3. Ductile iron pipe shall have flanged, grooved, push-on, or mechanical joints of the sizes and classes as shown on the Drawings or as specified herein. Unless otherwise shown on the Drawings, flanged and grooved joint ductile iron pipe

and fittings shall be used for non-buried service, while push-on and mechanical joint ductile iron pipe and fittings shall be used for buried service.

4. Unless otherwise shown on the Drawings, flanged and grooved joint ductile iron pipe shall be minimum thickness class 53 to enable threaded flanges or grooves for couplings/adapters.

5. Manufacturer's Statement: The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of this standard.

6. Ductile iron pipe shall be as manufactured by Clow Water Systems Company, American Cast Iron Pipe Company, U.S. Pipe and Foundry Co.

B. Lining, Coating and Marking

1. General

a. For ductile iron pipe, the class or nominal thickness, net weight without lining, and casting period shall be clearly marked on the exterior of each length of pipe. Additionally, the manufacturer’s mark, country where cast, year in which pipe was produced, and the letters “DI” or “DUCTILE” shall be cast or stamped on the pipe. Fittings shall have distinctly cast on them the standard to which the fitting conforms (AWWA C110 or AWWA C153), the pressure rating, nominal diameters of openings, manufacturer’s identification, country where cast, and the number of degrees or fraction of the circle on the bends. Ductile iron fittings shall also have the letters “DI” or “DUCTILE” cast on them. If required, the pipe, fitting, or special shall be marked to adequately show the proper location within the pipeline by reference to layout drawings and schedules.

b. Unless otherwise specified, the interior of ductile iron pipe and fittings shall have a cement mortar lining and asphaltic seal coat conforming to AWWA C104/ANSI A-21.4.

c. Ductile iron pipe and fittings used for buried applications shall have an asphaltic exterior coating not less than one (1) mil thick per AWWA C151, AWWA C110 and AWWA C153.

d. Ductile iron pipe and fittings that are exposed or immersed in liquid and not buried shall have an exterior coating suitable for the application and service as specified in Section 09 91 00 – Painting. Ductile iron pipe and fittings shall be delivered with a shop prime coat compatible with the exterior

coating system specified in Section 09 91 00 - Painting. The exterior of exposed or immersed ductile iron pipe and fittings shall be thoroughly cleaned prior to shop prime coating. See Section 09 91 00 for surface preparation requirements.

e. Exterior surfaces of castings to be encased in concrete shall not be coated.

f. Machined surfaces shall be cleaned and coated with a suitable rust preventative coating at the shop immediately after being machined.

C. Joints

1. Flanged Joints

a. Where shown on the Drawings, ductile iron pipe with flanged joints shall conform to AWWA C111/ANSI A21.11 and C115/ANSI A21.15. Flanged ductile iron pipe meeting these standards shall be flat faced and compatible with the following standards:

i. ANSI B16.1, Class 125.
ii. ANSI B16.5, Class 150, flat face only.
iii. ANSI B16.42, Class 150, flat face only.
iv. AWWA C207, Class B, D and E steel flanges only.

b. Flanges shall be ductile iron for use with ductile iron pipe. Use of gray iron flanges is not allowed.

c. For flanged pipe, the flanges, with long hubs, shall be screwed on the threaded end of the pipe in the shop and the face of the flange and end of the pipe refaced together. There shall be no leakage through the pipe threads, and the flanges shall be designed to prevent corrosion of the threads from outside elements. Flanges shall conform to the requirements of ANSI B16.1, Class 125, and shall be faced and drilled to that standard unless special drilling is called for or required. They shall be faced accurately at right angles to the pipe axis, drilled smooth and true, and shall be covered with zinc duct and tallow or white lead immediately after facing and drilling. Where tap or stud bolts are indicated, flanges shall be tapped.

d. Bolts, except as otherwise specified or indicated on the Drawings, shall meet the requirements of ASTM A193, Grade B8, Class 1, 304SS with ASTM A194, Grade 8 nuts.

e. Flanged joints for wall castings that are flush with the masonry or concrete

face shall be made up with Type 316 stainless steel stud bolts and nuts.

2. Plain End Joints

a. Pipe for use with sleeve-type couplings or as otherwise shown on the Drawings shall have plain ends (without bells or beads). The ends shall be cast or machined at right angles to the axis. Field cutting of plain ends shall be in accordance with manufacturer's instructions.

D. Fittings

1. Flanged Fittings

a. Fittings shall conform to the requirements of ANSI A21.10 and shall be at least Class 150.

b. Flanged fittings shall be faced and drilled in accordance with ANSI A21.10 except that special drilling or tapping shall be provided as necessary to ensure correct alignment and bolting.

c. Flanged fittings, which are not available under ANSI A21.10 (e.g. laterals or reducing ells), shall be furnished to conform to the requirements of ANSI B16.1 in the 125-lb. pressure class.

d. Fittings shall be provided with standard bases when so indicated.

2. Special Fittings

a. Fittings having nonstandard dimensions and cast especially for this project shall be of acceptable design. They shall be manufactured to meet the requirements of the same specifications and shall have the same diameter and thickness as standard fittings, but their laying lengths and types of ends shall be determined by their positions in the pipelines and by the particular piping to which they connect.

E. Gaskets

1. Unless otherwise shown on the Drawings, gaskets shall be SBR rubber; or approved equal. Gaskets for flanged joints shall be of the ring type meeting the requirements of ANSI B16.21. Gaskets shall be 1/16-inch thick for pipe 12-inch diameter and smaller and 1/8-inch thick for pipe larger than 12-inch diameter.

F. Items to be Furnished with Ductile Iron Pipe:

1. In addition to straight lengths of pipe, beveled pipe, access manholes, reducers, adapters, outlets, sleeves, caps, plugs, blind flanges, etc., there shall be furnished all fittings, elbows, bends, tees, closures, night-caps, bolts, nuts, etc., required for complete pipeline construction, as shown on the Drawings, or required by field conditions.

2. Furnish all rubber gaskets and all special materials required for making the joints and all special materials required to be incorporated in certain pieces of pipe or fittings, such as materials for restrained joints, etc., as shown on the Drawings.

3. The pipe supplier shall furnish a suitable number of closure pieces, shorts and adapters, which, though not specifically called for on the Drawings, may still be needed for the completion of the Work at no extra cost to the OWNER.

G. Installation requirements - In addition to the pipe manufacturer's installation guide, the following requirements shall be met:

1. Prior approval of the pipe manufacturer shall be required for the devices to be used to unload pipe, to move pipe, and to place pipe in the trench.

2. The pipe shall be unloaded, handled and placed using padded slings or other pipe manufacturer approved devices which distribute the weight of the pipe and prevent damage to the exterior coating, joint rings or pipe interior lining. The use of cables and other metal surfaces in contact with the pipe exterior is strictly prohibited.

3. Unloading or movement of the pipe by rolling or sliding at any time is strictly prohibited.

4. An acceptable device shall be used to distribute rubber gaskets uniformly around pipe on all joints.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Miscellaneous pipelines which are shown in diagram on the Drawings shall be arranged clear of other pipelines and equipment and be fitted and installed in a neat and workmanlike manner, in accordance with approved Shop Drawings. Adequate number of unions shall be provided in a main pipe and branch pipe runs to facilitate dismantling or removal of pipeline sections without disturbing adjacent branch or connecting lines.

B. Couplings will be permitted only to joint standard lengths of pipe and as required to complete a straight run of pipe. Joining by couplings, of random lengths of pipe and cutting from standard lengths to form a required run, will not be permitted.

C. Reducing fittings shall be used for all changes in pipe size. Brushing will not be permitted.

D. All pipe shall be transported, delivered, and installed in accordance with the manufacturer's requirements.

E. PVC pipes shall be used for the sump pump only. All other pipes shall be ductile iron pipe and fittings.

**3.2 FLANGED JOINTS**

A. Flanged joints shall be made with bolts or bolt studs with a nut on each end. Bolts, bolt studs, and nuts shall, except as otherwise specified or indicated on the Drawings, meet the requirements of ANSI B16.1 and ANSI B16.5. Steel flanges meeting ANSI B16.5 shall be flat faced when connecting to ANSI B16.1 iron flanges.

B. Flanged joints for wall castings that are flush with the masonry or concrete face shall be made up with Type 316 stainless steel stud bolts and nuts.

C. Flanged joints shall be made up tight, care being taken to prevent undue strain upon pump nozzles, valves and other pieces of equipment.

**3.3 WELDING**

A. Welding of pipe joints where shown, specified, permitted, or required shall meet the requirements of the ANSI Code for Pressure Piping, unless otherwise specified. Pipe and fittings with wall thickness of 3/16 inch and larger shall have ends beveled for welding.

B. Parts to be welded shall be securely held in place and in proper alignment during welding. The abutting pipe ends shall be separated before welding to permit complete fusion to the inside wall of the pipe without overlapping. Welding shall be continuous around the joint and completed without interruption.

C. Welds shall be single vee butt type, of sound weld metal thoroughly fused into the ends of the pipe and into the bottom of the vee. Welds shall be free from cold cuts, pinholes, oxide inclusions or other defects.

**3.4 TAPPED CONNECTIONS**

A. Tapped connections in pipe and fittings shall be made in such manner as to provide a watertight joint and adequate strength against pullout. The maximum size of taps in pipe or fittings without bosses shall not exceed that listed in the appropriate table of the Appendix to ANSI A21.51 based on 3 full threads for gray iron and 2 full threads for ductile iron.

B. Where the size of the connection exceeds that given above for the pipe in question, a boss shall be provided on the pipe barrel, the tap shall be made in the flat part of the intersection of the run and branch of a tee or cross, or the connection shall be made by means of a tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, all as indicated or permitted.

C. All drilling and tapping of ductile-iron pipe shall be done normal to the longitudinal axis of the pipe; fittings shall be drilled and tapped similarly, as appropriate. Drilling and tapping shall be done only by skilled mechanics. Tools shall be adapted to the work and in good condition so as to produce good, clean-cut threads of the correct size, pitch, and taper.

## 3.5 HANGERS AND SUPPORTS

A. All miscellaneous pipelines shall be permanently erected and supporting devices shall be furnished and installed as specified in Section 33 40 20, Pipe Hangers and Supports.

## 3.6 PAINTING

A. Painting shall be as specified in Section 09 91 00.

## 3.7 TRANSPORTATION AND DELIVERY

A. Every precaution must be taken to prevent damage to the pipe during transportation and delivery. Extreme care must be taken in loading and unloading the pipe and fittings. Such work must be done with the pipe under complete control at all times. Under no conditions may the pipe be dropped, bumped, dragged, pushed, or moved in any way that will cause damage to the pipe.

B. If in the process of transportation, handling, or installation, any pipe or fitting is damaged, such pipe or fitting must be replaced by the CONTRACTOR and be considered incidental to the construction and no additional payment will be allowed.

**END OF SECTION 33 40 10**

**DIVISION 33 - UTILITIES**

**SECTION 33 40 20 – PIPE HANGERS AND SUPPORTS**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED**

A. Erecting interior piping shall include providing supports, hangers and anchors, and installation of all interior and exposed exterior piping, valves, and appurtenances.

B. Piping materials, coatings, and linings shall be as specified or shown on the Drawings. Piping shall be installed where shown or specified.

C. Provide concrete pads for all floor mounted equipment.

**1.2 RELATED WORK**

A. Work under this Section is also subject to the requirements specified under Division 1 of these Special Provisions.

B. Division 5: Metals

C. Section 09 91 00: Painting

D. Section 33 40 10: Interior Pipe and Appurtenances

E. Section 33 40 30: Pipe Specialties

F. Section 43 01 50: General Mechanical Provisions

G. Section 43 20 10: Valves and Appurtenances

**1.3 REFERENCES**

A. American Society for Testing Materials:

1. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

B. Manufacturer's Standardization Society:

1. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

2. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

3. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

C. American National Standards Institute (ANSI):

1. B31.1: Power Piping Code.

D. American Welding Society (AWS) Code:

1. A2.0: Structural Welding Code D1-1-7.

## 1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Shop Drawings: Prior to fabrication, submit a copy of the CONTRACTOR'S piping layout drawing indicating location of supports, identified by hanger mark numbers.

C. Product Data: Provide manufacturer's catalog data for all components, including load capacity and dimensions.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

F. Shop and erection drawings stamped and signed by a Professional Engineer. Qualifications of manufacturer's Registered Professional ENGINEER stamping and sealing shop drawings and designs shall also be submitted if required by the ENGINEER. Shop and erection drawings shall include the following information:

1. Details of each support device with dimensions with a unique identification number.

2. A table of applied forces and/or moments.

3. A drawing showing the applied forces and moments.

4. Shop and field welds, including a description of each welding procedure.

G. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

## 1.5 BASIS OF PAYMENT

A. The work under shall be paid as part of the Contract lump sum price for PUMP STATION MECHANICAL WORK which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

## 2.1 DESIGN

A. Hangers and supports not detailed shall be adequate to maintain the pipelines, valves, apparatus and equipment in proper position and alignment under all operating conditions with due allowance for expansion and contraction, and shall have springs where necessary. Hangers and supports shall be of standard design where possible, and be best suited for the service required with a working safety factor of not less than five (5). They shall be screw adjustable after installation were applicable. Chain, strap, T-bar, perforated bar and/or wire hangers are not acceptable.

B. All supporting devices shall be designed to minimize interference with access and movement of valves and equipment. Injury hazard shall be considered and minimized in all protruding supporting devices.

C. Hangers and supports shall include proper pipe protection saddles on pipes which are covered with insulation.

D. Overhead hangers shall be supported by threaded rods properly fastened in place by suitable screws, clamps, inserts, bolts, or by welding.

E. Brackets for the support of piping from walls and columns shall be made of welded steel unless otherwise specified on the Project Drawings, and shall be designed for three maximum loads classified as follows:

Light 750 pounds

Medium 1,500 pounds

Heavy 3,000 pounds

F. When medium or heavy brackets are bolted to walls, backplates of adequate size and thickness shall be furnished and installed to distribute the load against the wall. When the use of backplates is not practicable, the brackets shall be fastened to the wall in a manner that the safe bearing strength of the wall will not be exceeded.

G. Pipe rolls or chairs shall be of cast iron. Pipe rolls shall be provided with threaded nuts or with sockets to take threaded rods.

H. Saddle stands shall be the adjustable type. Each stand shall consist of a length of steel pipe fitted at the base with a standard threaded ductile iron flange and at the top with an adjustable saddle or roll. The base flanges shall be bolted to the floor foundation or concrete wall.

I. Stanchions shall be of similar construction to the saddle stand, except that they shall be fitted at the top with cast-iron pipe saddle supports or with pipe stanchion saddles with yokes and nuts.

J. Where adjustable supporting devices are not required, pipelines 3 inches in diameter and smaller may be supported on ductile iron, malleable iron or steel hooks, hook plates, rings or ring plates.

K. Provide Type 316L stainless steel for pipe supports, hangers, guides, inserts, restraints, anchors, and appurtenant support items that are located in the wet well area and discharge chamber.

L. Contact between piping and dissimilar metals such as hangers, building structural work or equipment subject to galvanic action is not acceptable.

M. Manufacturers (or approved equal):

1. Anvil
2. Cooper (B-Line)
3. Approved equal

## 2.2 PIPE HANGERS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Carbon or stainless steel, adjustable swivel, split ring.

B. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and over: Carbon steel or stainless steel, adjustable, clevis.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.

E. Wall Support for Pipe Sizes 4 Inches (100 mm) and over: Welded steel bracket and wrought steel clamp.

F. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded. ASTM A283 or ASTM A36 unless noted otherwise.

## 2.3 PIPE SUPPORTS

A. Where piping of various sizes is to be supported together, space supports for largest pipe size and install intermediate supports for smaller diameter pipe.

B. Provide minimum of 2 pipe supports for each pipe run unless approved by the ENGINEER.

C. Where piping connects to equipment, support by a pipe support and not by equipment.

D. Arrange pipe supports so that there is no interference with maintenance or removal of equipment or operation of valves.

E. Unless otherwise indicated or authorized by ENGINEER, place piping running parallel to walls approximately 1-1/2 in. out from face of wall and at least 3 in. below ceiling.

F. Pedestal pipe supports: adjustable with stanchion, adjustable saddle, and anchoring flange. Stanchion size per manufacturer's recommendations depending on pipe diameter. Provide grout between base plates and floor.

G. Piping supports for vertical piping passing through floor sleeves: hot dipped galvanized steel riser clamps.

H. Support piping to prevent strain on valve, fitting, or equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise indicated. Do not install pipe supports in equipment access areas or bridge crane runs.

I. Do not support piping from other piping.

## 2.4 ANCHORS

A. Anchors shall be furnished and installed where specified, shown or required for holding the pipelines, valves, and equipment in position or alignment. Anchors shall be designed for rigid fastening to the structures, either directly or through brackets. The design of an anchor shall be subject to approval by the ENGINEER.

B. Anchors for piping shall be cast-iron chair type with steel straps, except where anchors form an integral part of pipe fittings or where an anchor of special design is required.

## 2.5 INSERTS

A. Inserts for concrete shall be galvanized unless noted otherwise, and be installed in the concrete structures where required for fastening supporting devices.

B. Inserts shall be designed to permit the rods to be adjusted horizontally in one plane and to lock the rod nut or head automatically. They shall be recessed near the upper flange to receive reinforcing rods.

C. Inserts shall be designed so that they may be held in position during the concreting operations and carry safely the maximum load that can be imposed by the rod which they engage.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

### 3.2 GENERAL

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.

C. Place hangers within 12 inches (300 mm) of each horizontal elbow.

D. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.

E. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Provide sheet lead packing between hanger or support and piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

K. Piping, ducts, conduits, valves, etc. shall be supported from structural members, slabs, etc. only, not from other pipes, ducts, conduits, etc.

L. Proceed with installation of pipe supports only after required building structural work has been completed and concrete support structure has reached its 28-day compressive strength.

M. Install pipe supports to allow controlled movement of piping systems. Permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

N. Prevent contact between dissimilar metals. Where concrete or metal pipe support is used, place 1/8 in. thick teflon, neoprene rubber, or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and pipe support.

O. Prevent electrolysis in support of copper tubing by use of pipe supports which are copper plated or plastic coated.

P. Perform welding in accordance with Structural Welding Code: Welding pipe wall attachments to pipe shall be governed by ANSI/ASME B31.1.

Q. Support piping to prevent strain on valve, fitting, or equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to nonrigid joints, and where otherwise indicated. Do not install pipe supports to limit access to equipment or maintenance areas.

R. All piping shall be firmly supported and anchored in proper position and alignment, with due allowance for expansion and contraction

S. Hanger rod diameters shall be as follows unless otherwise indicated by project drawings:

| PIPE SIZE<br>Inches (mm) | HANGER ROD DIAMETER<br>Inches (mm) |
|---|---|
| 1/2 to 1-1/4<br>(12 to 32) | 3/8 (9) |
| 1-1/2 to 2<br>(38 to 50) | 3/8 (9) |
| 2-1/2 to 3<br>(62 to 75) | 1/2 (13) |
| 4 to 6<br>(100 to 150) | 5/8 (15) |
| 8 to 12<br>(200 to 300) | 7/8 (22) |
| 14 and Over<br>(350 and Over) | 1 (25) |
| PVC (All Sizes) | 3/8 (9) |
| C.I. Bell and<br>Spigot(or No-Hub)<br>and at Joints | 5/8 (15) |

## 3.3 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches (100 mm) thick and extending 6 inches (150 mm) beyond supported equipment for all floor mounted equipment.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

E. Center thrust anchors between expansion joints and between elbows and expansion joints for suspended piping. Anchors must hold pipe rigid to force expansion and contraction

movement to take place at expansion joints and/or elbows and to preclude separation of joints.

## 3.4 PIPING HANGERS AND SUPPORTS

A. Unless otherwise specified or shown on the Drawings, or required by job conditions, hangers and supports for ductile iron horizontal pressure piping shall be installed as follows:

1. For Flanged Joint Piping: For pipe 3-inch to 24-inch diameter, minimum 2 hangers for each length 12 ft. or longer and 1 hanger for each length less than 12 ft. long.

B. Unless otherwise specified or shown on the Drawings, or required by job conditions, hangers and supports for horizontal steel piping shall be installed as follows:

| Nominal Pipe Size, In. | Maximum Spacing, Ft. |
|---|---|
| 1/8 through 1-1/4 | 7 |
| 1-1/2, 2 | 10 |
| 2-1/2 through 3-1/2 | 12 |
| 4, 5 | 15 |
| 6 | 16 |
| 8 through 12 | 16 |
| 14 | 18 |
| 16, 18 | 20 |
| 20 | 22 |
| 24 | 24 |
| 30 | 24 |

C. Unless otherwise specified or shown on the Drawings, or required by job conditions, hangers and supports for horizontal copper piping shall be installed as follows:

| Nominal Pipe Size, In. | Maximum Spacing, Ft. |
|---|---|
| 1/4 through 5/8 | 5 |
| 3/4, I | 6 |
| 1-1/4 through 2 | 7 |
| 2-1/2 through 4 | 9 |

D. Unless otherwise specified or shown on the Drawings, or required by job conditions, spacing of hangers and supports for horizontal PVC piping shall be six (6) feet for all sizes.

E. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the

CONTRACTOR shall submit a Certification from the manufacturer stating that such requirements have been complied with.

## 3.5 PAINTING

A. Hangers, supports, anchors, and similar devices, not galvanized, shall be painted in accordance with Section 09 91 00, Painting.

**END OF SECTION 33 40 20**

**DIVISION 33 - UTILITIES**

**SECTION 33 40 30 – PIPE SPECIALTIES**

**PART 1 - GENERAL**

**1.1 GENERAL**

A. Provide pipe specialties as specified on the project drawings, as specified herein, and as needed for a complete and proper installation.

B. The CONTRACTOR shall provide labor, materials, tools and equipment as necessary to install all fittings and accessories required for the completion of all pipelines covered in this Section.

C. Performance tests on all items submitted shall be performed in accordance with the guidelines set forth in this Section, Section 33 40 10, and as recommended by the manufacturer.

D. The sizes, types and classes shall be as shown on the Contract Drawings.

**1.2 RELATED WORK**

A. Work under this Section is also subject to the requirements specified under Division 1 of these Contract Documents.

B. Section 09 91 00: Painting

C. Section 33 40 10: Interior Pipe and Appurtenances

D. Section 33 40 20: Pipe Hangers and Supports

E. Section 43 01 50: General Mechanical Provisions

F. Section 43 20 10: Valves and Appurtenances

**1.3 REFERENCES**

A. Pipe Specialties shall be in accordance with the specification standards as indicated in Section 33 40 10, Interior Pipe and Appurtenances, and as stated herein.

## 1.4 QUALITY CONTROL

A. All materials furnished shall be from an established and reputable manufacturer or supplier with at least 5 years of experience.

B. All pipe and appurtenances shall be new and of first class materials and construction. They shall be guaranteed to perform the services required and shall conform to the Special Provisions herein.

## 1.5 SUBMITTALS

A. The required number of copies of shop drawings shall be provided in accordance with Division 1 of these Special Provisions.

B. The CONTRACTOR shall submit material data sheets and detailed drawings of Piping Specialties demonstrating compliance with these Special Provisions.

C. Technical data on coatings and linings as well as a description of application method.

D. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

## 1.6 BASIS OF PAYMENT

A. The work under shall be paid as part of the Contract lump sum price for PUMP STATION MECHANICAL WORK which shall be payment in full for the work described herein.

# PART 2 - PRODUCTS

## 2.1 EXPANSION

A. Provisions for flexibility in all pipelines shall be provided to allow the lines to expand and contract freely without injury to piping systems. The devices may be in the form of expansion joints, expansion couplings, swivel or swing joints or pipe bends, and shall include such anchors as may be shown, specified or required to make the devices effective.

B. If expansion devices are not required, all runs of pipe subject to change in length shall be fabricated shorter than their theoretical length to the extent that there may be freedom to expand without increasing the stresses imposed when cold.

C. Slip type expansion joints, having suitable packing shall be provided for the PVC piping in the manner and at the intervals recommended by the pipe manufacturer.

D. Expansion joints shall be provided with adequate tie rods to limit the axial movement at the specified test pressures.

E. Mechanical expansion joints shall be Style 63 as manufactured by Dresser Industries, or approved equal.

## 2.2 WALL SLEEVES AND CASTINGS

A. Wall castings and make-up pieces shall meet the requirements of AWWA C100 and shall be a minimum of Class B. Special fittings, where required, shall be of an approved design, and laying lengths and other functional dimensions shall be determined by their positions in the pipelines and by the particular piping materials to which they connect.

B. All wall castings and sleeves below grade and at other required locations shall be watertight. Where water-tightness is essential and at other locations where indicated, wall castings or sleeves shall be provided with an intermediate flange located approximately at the center of the wall.

C. The CONTRACTOR shall install suitable sleeves at all points where pipes pass through walls or floors of structures where wall castings are not provided. Sleeves inside buildings and between floors shall be of steel with a minimum thickness of Schedule 40 and the space between the pipe and the sleeve shall be caulked with lead and oakum. Sleeves through walls of structures shall be cast iron solid sleeves, meeting the requirements of AWWA C100 with caulked bell and spigot or mechanical joint ends or link seal.

D. Where indicated, the space between the pipe and sleeve shall be sealed using a mechanical link-type closure as manufactured by Thunderline Corporation or approved equal. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely water-tight seal between the pipe wall opening. Sleeves shall be cast iron of size recommended by the manufacturer of the link-type closure.

E. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by the ENGINEER. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two pipe sizes larger than piping run. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves 1/4" above level floor finish, and 3/4" above concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

F. Sleeves for installation in core drilled exterior walls shall be as follows:

1. Schedule 40 black steel pipe with ends cut square and reamed of sufficient length to carry 1/8-inch thick square steel base plates at both ends of the sleeve. Base plates to be 2 inches greater than sleeve diameter. The sleeves shall be of sufficient size to permit the full specified thickness of insulation or piping to pass through sleeve. Base plates shall be screwed into wall.

2. Spaces between pipe and wall sleeves shall be caulked with Minnesota Mining & Mfg. Co. Scotch Seal Brand #612 or approved equal sealant. Where space exceeds ½ inch, tightly pack first with 1.58 lb. density fiberglass and then caulk both ends with sealant specified.

## 2.3 DIELECTRIC COUPLINGS

A. Where connections between pipelines or equipment of corrosion causing dissimilar metals are required, the junction of the two dissimilar metals shall be made through a dielectric insulating coupling, union, or other approved dielectric insulating device.

## 2.4 SLEEVE TYPE COUPLINGS

A. For sleeve type couplings, diametrically opposite bolts shall be equally tightened on the connection so that the gaskets will be brought up evenly all around the pipe. Final tightening shall be done with torque wrenches set for the torque recommended by the coupling manufacturer.

B. Sleeve-type couplings for exposed ductile iron pipe shall be of steel and shall be Style 38 or 253 couplings as made by Dresser Industries, Inc., or approved equal. The coupling shall be provided with steel bolts and nuts.

C. Flanged coupling adaptors shall be Style 128 as made by Dresser Industries, or approved equal.

D. Sleeve type couplings shall be shop coated with Dresser Red "D" Shop Coat, Smith-Blair Standard Blue Shop Coat, or approved equal nontoxic material. Finish Coast shall be as indication in Section 09 91 00, Painting.

E. Couplings shall have a minimum pressure rating equal to the test pressure of the pipeline.

F. All couplings shall be furnished with the pipe stop removed.

G. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid or gas within the pipe.

## 2.5 FILLING RINGS

A. The CONTRACTOR shall provide suitable filling rings where the layout of the flanged piping is such as to necessitate their use. In materials, workmanship, facing, and drilling, such rings shall conform to the AWWA C111/ANSI A21.11 or C115/ANSI A21.15 Standards. Filling rings shall be of suitable length with nonparallel faces and corresponding drilling, if necessary, to ensure correct assembly of the adjoining pipe or equipment.

## 2.6 CORPORATION CONNECTIONS

A. Valves, materials, and installations shall conform to AWWA C800 and ASTM B62. All taps shall be direct and shall not require saddles unless indicated otherwise on the Drawings. Corporation connections shall be installed at the sizes and locations indicated on the Drawings.

B. Corporation valves shall be ball type rated for a working pressure of 300 psig.

C. Corporation connection materials shall be manufactured by Mueller, Ford Meter Box, Kitz Corporation, Griffco Valve, and Legend Vave.

# PART 3 - EXECUTION

## 3.1 GENERAL

A. Couplings will be permitted only to joint standard lengths of pipe and as required to complete a straight run of pipe. Joining by couplings, of random lengths of pipe and cutting from standard lengths to form a required run, will not be permitted.

B. Reducing fittings shall be used for all changes in pipe size. Brushing will not be permitted.

## 3.2 HANGERS AND SUPPORTS

A. All miscellaneous pipelines shall be permanently erected and supporting devices shall be furnished and installed as specified in Section 33 40 20, Pipe Hangers and Supports.

### 3.3 PAINTING

A. Painting shall be as specified in Section 09 91 00 of the Special Provisions.

### 3.4 TESTING

A. See individual specification sections in which piping specialties are installed for testing procedures for piping systems.

**END OF SECTION 33 40 30**

**DIVISION 40 – SCADA SYSTEM**

**SECTION 40 94 23 – SCADA SYSTEM**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

A. The requirements of the Special Provisions and Division 1, General Requirements, shall apply to all SCADA SYSTEM described herein.

B. The SCADA (Supervisory Control and Data Acquisition) system shall be provided to function as the "Master Control Station" for the Pump Station facility.

C. The SCADA will be a PLC based system with an operator interface mounted on SCADA Panel SP38 for control, monitoring and system configuration. The following equipment and instrumentation, as a minimum, will be monitored/controlled via hardwired connections:

1. Main Switchboard
2. Motor Control Center
3. Automatic Transfer Switch
4. Pump Motor Controllers and Protection Devices
5. Level Sensing Systems
6. Pavement Float Switches
7. Combustible Gas Detection System
8. Fire Detection and Alarm System
9. Intrusion Detection System

a. The operator interface shall consist of a graphical interface which provides a view of the pumping station. Several “screens” shall be designed in order to display the features of the facility.

b. The SCADA system shall consist of, but not be limited to; programmable controllers, data communication equipment, displays as noted, process instrumentation and control devices, uninterruptible power systems (UPS), and other devices as required and/or as indicated on Plans.

c. All materials, equipment, labor, programming, configuration and installation services, and incidentals required to achieve a fully integrated and operational system shall be furnished and installed complete by a qualified Contractor with a minimum of 10-years of experience. The Contractor shall design and coordinate the instrumentation and control system for proper operation with related equipment and materials.

d. Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with equipment provided under this Contract shall be included whether shown on the Plans or not.

e. The Contractor shall provide all programming and configuration of equipment and software including development of graphic displays and

reports. Displays and Report development shall be coordinated with existing owner standards.

f. The Contractor shall install the control system and shall perform all on-site testing, start-up, and training of owner's staff.

g. All necessary coordination required for interfacing the proposed pump station facility with the proposed SCADA system shall be provided by the Contractor.

## 1.2 RELATED SECTION

A. Section 01 01 01 – Summary of Work

B. Section 26 24 13 – Switchboard

C. Section 26 24 19 – Motor Control Centers

D. Section 26 36 23 – Automatic Transfer Switches

E. Section 28 31 00 – Fire Detection and Alarm

F. Section 28 35 10 – Combustible Gas Detection System

G. Section 40 94 24 – HMI Improvements

H. Section 43 20 10 – Valves and Appurtenance

I. Section 43 21 39 – Submersible Pumps

J. Section 43 21 43 – Sump Pumps

## 1.3 REFERENCES

A. ISA Standards and Recommended Practices for Instrumentation and Control.

## 1.4 SUBMITTALS

A. Submit product data, shop drawings, project documentation, O & M Data and record documents in accordance with the provisions of Specification Section 01 01 01 Part 1.6 - SUBMITTALS and the following specific information.

B. Product Data

1. Bill of Material: List all the materials and equipment to be furnished. Tag number, manufacturer's complete catalog number, service, location, and cross-reference numbers of instruction sheet, specification data sheet and wiring diagram shall be included under each item.

2. Specification Data and Drawings: Furnish instrument specification data sheet as per ISA standard instrument specification form, if applicable, wiring and/or connection diagram, outline dimensions, installation diagram and manufacturer's catalog for each instrument. A common set of drawings with setting and/or scale

individually listed may be furnished for instruments with identical specification except setting and/or scale.

3. Panel Drawings: Furnish panel drawings for each instrument/control panel. List bill of materials, show panel or cabinet structure, outline dimension, general arrangement, devices, cutouts and mounting details of instruments and control devices, terminal blocks, wire ways and piping.

C. System Diagrams

1. Instrument Loop Diagram: Show all analog and digital loops for all instrument sensors, secondary instruments, I/O functions, alarms, control and displays using ISA standard symbols per ISA Standard S5.4.

2. SCADA System Block Diagram: Show system hardware configuration and identify model numbers of each system component.

3. Schematic diagrams, point-to-point internal wiring diagrams, point-to-point field wiring diagrams, and other necessary diagrams and installation requirements for the SCADA system and other components and systems that are interfaced to these systems.

4. Interconnecting Wiring and/or Piping Diagrams: Show schematically the wiring and piping runs for each instrumentation and control system. The diagram shall show and identify, with location noted, all instruments, piping and appurtenances furnished under this section and related electrical equipment furnished under other Sections. All terminal blocks and pipe taps shall be identified.

D. Software Documentation

1. Submit system software, application software, I/O point data base listing, programming ladder diagrams, graphic pages and report forms in prints. Software, application programs, ladder diagrams and control logics shall also be submitted in 740MB CD-R.

E. Instruction Manuals

1. Submit instruction manuals covering installation, operation, calibration, maintenance, diagnostic and repair for all hardware and software.

F. Record Documents

1. Accurately record actual calibration setting and scales of instruments.

## 1.5 WORK FOR HIRE

A. Any and all configuration, programming, setup or other software functions (SOFTWARE) performed on all intelligent devices provided as part of this Project is to be considered “Work for Hire” under the 1976 Copyright Act as amended (title 17 of the United States Code). The SOFTWARE shall be owned by the owner and shall be turned over to the owner. All paperwork shall be fully documented as the work is completed and turned over to the owner upon completion of work.

B. The owner intends only to obtain the SOFTWARE for its own use.

C. The owner will not prevent the SOFTWARE supplier from reuse of the SOFTWARE concepts and ideas for other projects. Any reuse of the SOFTWARE concepts and ideas generated under this Project is solely the responsibility of the SOFTWARE supplier. The SOFTWARE supplier shall defend, indemnify and hold the owner harmless from all claims, damages and expenses (including reasonable litigation costs), arising out of any use, misuse or misapplication of SOFTWARE concepts and ideas.

## 1.6 OPERATIONAL AND PERFORMANCE REQUIREMENTS

A. General

1. The SCADA System will be designed for full automatic control and monitoring of the pump station. The individual pumps in the station will be called to start and stop due to the water level in the wet well. Under normal conditions, the water level is measured via a primary (ultrasonic) and secondary (pressure transducer) redundant level sensors. The station will also be equipped with a direct action float switch level system as a backup to the primary and secondary level systems. Finally, the control system will also allow for manual operation.

2. The Low Flow Pump will be the first pump to start and the last one to stop. The Main Flow Pumps (MFP-1, MFP-2 and MFP-3) will operate in a 3-pump alternator sequence with one of the pumps designated as a standby. The operator shall select which pump shall be designated as standby via a selector switch mounted on SCADA Panel SP38. The lead and lag pump alternation shall occur when all pumps are off in a pumping cycle. System operation shall be the same no matter which level control system is functioning.

3. The SCADA system will interface with the City of Lake Forest's supervisory control system via a fiber optic Ethernet connection and a wireless modem data connection will be provided for backup. The fiber optic cable connection shall be provided by others in the future. The SCADA system shall be designed to allow for control of Pump Station 38 from remote location in the future.

B. Manual Pump Operation

1. The Pump Station includes (4) pumps. Each of the (4) pump motors are equipped with a starter with a Manual/Off/Auto selector switch. When the switch is in the Manual mode, the respective pump will immediately start, assuming no fault conditions. When in Auto mode, the respective pump shall be started and stopped based on Sequence of Operation detailed below.

C. Automatic Pump Operation

1. The pump operation shall be automatically staged based on the water level in the wet well. The level in the wet well shall be monitored via (2) independent level sensing systems. The main level sensing system shall consist of primary (ultrasonic) and secondary (pressure transducer) systems. The level transducers shall monitor the wet well liquid level and generate electronic analog process control signals proportional to the head of liquid. The signals shall be monitored by a Programmable Logic Controller (PLC)located in SCADA Panel (SP38). The PLC establishes the "ON-OFF" set points for the (4) pumps based on wet well

conditions. Pump operating sequence and pump availability is also established via the PLC.

2. On a rise in wet well liquid level, the Low Flow Pump motor will start. With the low flow pump running and a further rise in liquid level, the lead pump setpoint causes the lead motor to start and the low flow pump to stop. With the lead pump running and a further rise in liquid level, the lag pump setpoint causes the lag motor to start. As the wet well liquid level falls, the pumps stop in succession in response to commands by the PLC.

3. The following tables summarize the sequence of pump operation for rising and falling wet well conditions.

| **Rising Wet Well Condition** | |
|---|---|
| Wet Well Level Elevation | Pump Operation Sequence |
| 645.70 feet | Low Flow Pump Start |
| 648.70 Feet | Lead Main Flow Pump Start / Low Flow Pump Stop |
| 649.20 feet | Lag Main Flow Pump Start |
| 652.00 feet | High Water Alarm |

| **Falling Wet Well Condition** | |
|---|---|
| Wet Well Level Elevation | Pump Operation Sequence |
| 647.40 Feet | Lag Main flow Stop |
| 646.40 Feet | Lead Main Flow Pump Stop / Low Flow Pump Start |
| 644.40 Feet | Main Flow Pump Failure To Stop Alarm |
| 644.80 Feet | Low Flow Pump Stop |

| | |
|---|---|
| 642.50 Feet | Low Water Alarm |

4. The next main flow pump (including the pump designated as standby) in sequence will automatically start in the event the lead or lag main flow pump fails to start for whatever reason when automatically required by the control system. The failed pump is removed from automatic service and is by-passed by the controller until manually reset.

D. Automatic Pump Operation Via Float Switch Leveling System

1. The backup level sensing system shall be a series of (8) floats. The system will only be active if the primary and secondary level monitoring system, as described above, fails or if the operator selects float operation via a selector switch mounted on SCADA Panel SP38. The floats shall be mounted at specific levels in the wet well. Refer to the FLOAT CONTROL SYSTEM Section of this Specification and Plans for additional details.

2. The pump operation shall be automatically staged based on the water level in the wet well. The control of pump operation shall be identical shall be identical to that described above for the Automatic pump operation system. The PLC shall not be used for pump control and staging when the Float Switch Level System is operating. Rather relay logic as detailed on the Plans shall be used.

E. Integrated Protective Controls

1. The control system shall include the following protective features to protect the motor. These features shall be active in manual and automatic modes of operation no matter which type of leveling sensing system is active.

   a. Low Level Cutout shall inhibit pump operation upon occurrence of a predetermined low liquid level in the wet well. The SCADA panel SP38 shall identify this condition via an alarm. Restoration of pump operation is automatic upon rise in wet well liquid level to the predetermined set point.

   b. Dedicated Pump Over temperature Relay monitors thermal switches in the respective pump motor windings and locks-out pump operation upon occurrence of a high motor temperature. A door mounted pilot light indicating “OVERTEMP” is energized while the motor is locked-out. The affected pump motor remains locked-out until the associated “RESET” pushbutton is depressed following correction of the problem. A door mounted selector switch shall provide the operator with the option of bypassing the lock-out feature. Refer the motor wiring diagrams for additional details.

   c. Dedicated Pump Seal Probe Relay monitors moisture probes in the oil seal chamber of the pumps. The presence of moisture activates the associated probe relay, which locks-out the associated pump and energizes a door-mounted pilot light (“SEAL FAILURE”). The affected pump motor remains locked-out until the associated “RESET” pushbutton is depressed following correction of the problem. A door mounted selector switch shall provide the operator with the option of bypassing the lock-out feature. Refer the motor wiring diagrams for additional details.

d. Refer to the motor wiring diagrams for additional motor protective details.

## 1.7 GUARANTEES AND WARRANTEES

A. Guarantees and warrantees shall be provided in accordance with the provisions of Specification Section 01 01 01 Part 1.7 – Guarantees and Warrantees and the following specific information.

B. Contractor shall provide a one year warranty from dated of final acceptance, including parts and labor.

C. All hardware and software furnished under this contract including but not limited to the microprocessors, accessory peripherals, discrete devices, analog instruments and control devices shall be unconditionally guaranteed.

## 1.8 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, SCADA SYSTEM.

## 1.9 DELIVERY, STORAGE AND PROTECTION

A. Deliver, store, protect and handle products to site under provisions of Division 1.

## 1.10 SCADA SYSTEM I/O

A. Refer to the Plans for details regarding I/O requirements.

## 1.11 MASTER PLC I/O POINTS VIA ETHERNET

A. Motor Control Center MCC-38

1. The following data points shall be transmitted from the MCC digital customer metering package to SCADA panel SP38:

a. ComEd Service Main breaker position indication and trip indication
b. ComEd Service Failure
c. ComEd Service Power Failure
d. ComEd Service Ground Fault
e. NG Generator Service Main breaker position indication and trip indication
f. NG Generator Service Failure
g. NG Generator Service Power Failure
h. NG Generator Service Ground Fault
i. ATS in normal position
j. ATS in emergency position
k. ATS in test mode
l. ATS ready to load

## 1.12 PLC I/O POINTS VIA CONTROLNET

A. There are two redundant PLCs, PLC-SP38-01 & PLC-SP38-02, located in SCADA Panel SP38. The PLCs are connected via a redundant ControlNet network configuration.

1. SCADA Panel PLC Trouble – Alarmed when trouble is sensed for PLC-SP38-01 or PLC-SP38-02

2. SCADA Panel PLC Failure– Alarmed when PLC-SP38-01 or PLC-SP38-02 fails.

3. The three PLCs shall monitor the status of the other PLCs. A PLC “Trouble Alarm” shall be triggered for any general fault that is sensed. A PLC “Failure” shall be triggered if it is sensed that a PLC has failed.

B. All I/O data that is monitored or controlled at the Pump Station shall be available for transmission to the owner. The data shall be used for the development of Human Machine Interface (HMI) Screens. Refer to Specification Section 40 94 24 – HMI Improvements for additional details.

## 1.13 SYSTEM DESCRIPTION

A. The following points are not intended to be a comprehensive list of the system’s features, only summarize the major functions of the system. The SCADA system specified herein shall perform the following generalized functions:

1. Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.

2. Collection and store accurate, reliable operating information for present and future uses.

3. Assist plant operating personnel by noting and communicating, off-normal operating conditions and equipment failures.

4. Accumulate and store equipment running times for use in preventative maintenance.

5. Provide color graphic displays and summary reports for use by the plant operating and supervisory personnel.

6. Provide trending for all analog values.

7. Provide control system diagnostics.

B. The system is based on the SCADA system block diagram shown on Plans. The system shall include:

1. Graphical Interface Panel (GIP)

2. Programmable logic controllers (PLCs) with local input/output (I/O)

3. Network Communications

4. Other capabilities as specified herein and shown on the SCADA system block diagram.

C. All process control functions including PID, calculations, sequencing, set points, timing, etc., shall be done in the PLCs.

D. The system shall allow the operator to monitor the status of pumps and other equipment (i.e., on-off, set point value, etc.) when viewing the GIP Screens.

## PART 2: PRODUCTS

### 2.1 SCADA PANEL SP38 (LOCATED IN ELECTRICAL ROOM)

A. The SCADA Panel shall house redundant PLCs, which shall be programmed for monitoring Pump Station operations. The PLC shall control the starting and stopping of the low flow pump and the three main flow pumps to prevent roadway flooding. The PLC shall also be responsible for control and monitoring functions performed at the station. The PLCs shall interface with an Ethernet switch and cellular modems for communication with the owner. Refer to the Plans for additional details.

### 2.2 PROGRAMMABLE LOGIC CONTROLLERS

A. Manufacturers

1. Allen-Bradley, no substitutions allowed.

B. An Allan-Bradley programmable logic controller (PLC) system shall be furnished and programmed to operate all functions herein specified. All analog and discrete inputs and outputs shall be provided as necessary. The logic program shall be of universal type architecture and shall not be of a proprietary language. In addition, the programmable controller shall be capable of being monitored from remote facilities via cellular modems and an Ethernet Network communication system. The programmable controller equipment supplier shall be responsible for coordinating and providing a complete and properly functioning software package for the control and operation of the equipment as specified herein.

C. The Contractor shall furnish the station operational program. A CD ROM copy and printout of the PLC control program shall be furnished to the owner at the time of start-up. Disk and printed copy of the operating program shall be maintained on the file with the Contractor.

D. SCADA Panel PLCs PLC-SP38-01 & PLC-SP38-02: The system shall consist of two (2) redundant Control Logix processors, two (2) Control Logix System Redundancy Modules, two (2) Control Net communication interfaces, two (2) Ethernet modules, two (2) redundant hot-swappable power supplies, (1) Graphic Interface Panel (GIP), necessary cable assembly, and necessary specialty modules to form a complete system. The PLC shall be Allen-Bradley Control Logix Redundant System with sufficient memory and I/O capacity to handle monitor and control functions of the system plus 25% spare memory. The PLC shall be mounted in the Electrical Room SCADA Panel SP38 and shall be programmed for monitoring and control functions.

## 2.3 PLC PROGRAM DEVELOPMENT SOFTWARE SYSTEM

A. The Contractor shall provide as part of the System a software package to allow off-line or on-line ladder logic program development, annotation and monitoring on an IBM or compatible personnel computer operating under the computer operating system specified herein.

B. The software shall be utilized for development of the ladder logic programs and transfer to the PLC. Provide all PLC configuration required to implement the control strategies specified in this Section and as shown on the Plans.

C. The software package shall be completely menu driven and shall be distributed on standard CD's.

D. All required hardware (including cables, cable adapters, etc.) to allow the PLC's connection to a Standard RS-232-C or USB personal computer port shall be furnished.

E. The software package shall include a software license agreement allowing the owner the rights to utilize the software as required for any current or future modification, documentation, or development of the PLC's furnished for this project.

F. The software shall provide as a minimum the following functions.

1. Annotation of all ladder elements with at least 3 lines of 6 characters each.

2. Annotation of all ladder rungs with at least 240 characters.

3. Provide visual "power flow" monitoring of circuit elements (when connected to the PLC).

4. Provide annotated ladder diagram printout for documentation purposes.

5. On-line help facility.

6. Download or upload ladder program from the PLC to the PC.

7. Provide a ladder element and I/O cross reference table.

8. Provide all monitoring, forcing, programming error detection, searching, configuration, etc., functions as required to allow an operator/programmer to completely program a PLC.

G. Programming software shall be Allen-Bradley RSLogix 5000 or current programming software compatible with the owner's standards. Software shall be suitable for simultaneous operation with the computer based control system software specified herein. Provide means for development software operation without affecting on-line operation of the computer control system.

## 2.4 PLC PROGRAM SOFTWARE DEVELOPMENT PHASE

A. The Contractor shall provide all PLC programming and configuration of equipment and software to ensure a fully functional system per the Plans and Specifications. Software development shall be coordinated with existing owner standards

B. Specific details regarding the programming standards are not provided as part of the specification. As part of the PLC Program Software Development Phase, the detailed requirements for the PLC Programming shall be provided. Refer to Part 3 of this Specification for details regarding the PLC Program Software Development Phase. The Contractor is responsible for providing and developing all software to meet this Specification and to ensure a functional system that meets the owner's operational requirements.

## 2.5 GRAPHICAL INTERFACE PANEL (GIP)

A. Provide two (2) x 22" minimum, with an active matrix TFT colored display, graphical interface panels incorporated into the PLC system as shown on the Plans. Graphical interface panel shall be configured to allow operator access to status and control of local processes being monitored by the PLC. Provide all software, hardware, cables, and appurtenances for a fully configured system.

B. Provide industrial grade sealed panel suitable for panel mounting with keypad. Keypad shall include a minimum of 15 user definable panel buttons and 5 user definable control buttons. Provide 15 inch, 1024 x 768 pixel, 18-bit color graphics, active-matrix TFT display.

C. Provide PLC communications interface drivers to allow direct access of the graphical interface panel to the PLC and network. During configuration, the Contractor shall assign specific addressing and input/output access to allow monitoring of the specific local process. Provide a minimum of two configurable serial local ports. Provide a minimum of two configurable serial communication ports.

D. Provide Windows based configuration software with the graphical interface panels. Configuration software shall utilize fill-in-the-blank style structure and support a minimum of 30 control display pages per panel. Control pages shall be stored in non-volatile EEPROM memory. Configuration shall be performed using the POWS device specified herein.

E. Provide screen templates for screen configuration including discrete indicator, analog numeric readout, message text display, graphical analog bar, register table, alarm windows, and control button. Panel software shall allow mixing of custom graphics and templates on any page configuration. Provide variable sizing of templates with no limitation on the number of elements on any alarm page.

F. Provide custom graphic capability for a schematic, graphical representation of the process. Resolution of graphics shall be to the screen pixel level. Custom graphics shall have the ability to be animated including proportional and status color based strategies. Provide a library of pre-developed symbols based on ISA graphical standards.

G. Provide alarm monitoring capabilities with audio output. Alarm buffer shall store a minimum of 100 alarms for scrolling, review, and acknowledgment by the operator using an alarm summary page. Provide alarm acknowledge and audio output silence logic. Alarm audio output shall be adjustable up to 2 watts maximum.

H. Provide capacity for a minimum of 500 text messages.

I. Provide all configuration, transfer and graphics software as required.

J. Unit shall operate from 24V DC power source. Operating temperature range shall be 0-50ºC with 20-80% humidity range, non-condensing. Provide a single Form C alarm fault contact rated a minimum of 1A at 120 VAC. Contact shall be wired into a discrete input of the PLC serving the GIP.

K. Graphical interface panel shall be Allen-Bradley PanelView Plus 1500.

L. The monitor shall be equipped with a widescreen aspect ratio and interface with the SCADA system through computer mounted back of panel.

## 2.6 GIP SOFTWARE CONFIGURATION

A. General: The GIP graphical presentation shall present graphic logic for the Panel View monitor. Specific details of the graphical presentation at the GIP are not necessarily shown on the Plans or described in the Control Descriptions. As part of the GIP Graphical Screen Development Phase, the detailed requirements for the GIP screens shall be defined. Refer to Part 3 of this Specification for details regarding the GIP Graphical Screen Development Phase. The Contractor is responsible for providing and developing all software and graphical interfaces to meet this Specification and to ensure a functional system that meets the owner's operational requirements.

B. The GIP shall provide the following screens as a minimum. This is a general listing. Additional "drilldown" screens may be required in order to present the graphical details in manner that is conducive to viewing by the operator. The final list of required screens shall be developed during the GIP Graphical Screen Development Phase.

1. Main menu and navigation screens for the GIP screens presented in a general to specific hierarchy

2. GIP Help screen(s) that summarize operator interface formats, use of function keys, navigational standards, etc.

3. System alarm screen that presents a list of critical system wide alarms. Operator acknowledgment of all system alarms shall be possible at the GIP panel. Refer to the Plans for additional details.

4. Local alarm screen that presents a list of local process alarms. Operator acknowledgment of all system alarms shall be possible at the GIP panel.

5. System status screens that summarize the present operational status of the major pump station equipment such as pumps, sluice gates, motorized valves, meters, floats, transducers, etc.

6. Electrical Distribution system one-line showing the status of the (2) Electrical Services, ATS, (2) main circuit breakers, circuit breakers feeding (4) pump motors mounted in the MCC, etc.

7. Customer Metering Screen detailing information gathered via the MCC digital metering equipment and ammeter information for the individual motors.

8. Building Status Screen that provides details on the status of room temperatures, Metal bar rack Differential Level, Combustible Gas Alarm Panel, Intrusion Alarm Panel, Fire Alarm Panel, Pavement Flooded Status, Sump Pump Panel, UPS status, PLC Status, etc.

9. GIP Interface Screens shall match, to the greatest extent possible, the owner's standard formats used at other pump station installations. Details regarding the owner's standard formats shall be provided during the GIP Graphical Screen Development Phase.

## 2.7 ETHERNET DATA SWITCHES

A. Manufacturers:

1. Allen Bradley Stratix 6000 Fixed Managed Switch.
2. Or equal.

B. Features:

1. Modular Ethernet expandable switch. Locate equipment in enclosure to allow addition of one additional "expansion module" in the future, including sufficient length of DIN rail.

2. Store and forward switch in compliance with IEEE 802.3.2 priority classes in accordance with IEEE 802.1D, TCP/IP protocol

3. As a minimum the switch shall have the following port configuration:

a. (8) 10/100 Base T Mbps Auto Sensing Copper ports with RJ45 connection.

b. (1) 1000 Mbps fiber port

c. Ambient temperature (operation) - 0ºC to 55 ºC.

d. Humidity: 10% to 95% non-condensing.

## 2.8 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM

A. Uninterruptible Power Supplies (UPS) System shall be provided for the SCADA and instrumentation systems as shown on the Plans and specified herein. The UPS shall sustain operation during short-term power failures, and shall provide power for an orderly shutdown to prevent the loss of data during power failure and shall provide isolation between the control system and the plant power system.

B. The UPS shall be a single phase, true on-line, solid unit with microprocessor controlled static inverter, hot pluggable batteries, battery charger, LED display and keypad.

C. Under normal operating conditions, the critical load shall be continuously supplied by the UPS inverter. The battery charger shall maintain a float-charge on the battery. When AC line power fails, or goes out of tolerance, the inverter shall obtain power from the batteries and supply AC power to the loads without interruption.

D. The UPS system shall be sized to sustain 1.5 times the connected full load for a minimum period of 30 minutes in an operating environment of 32°F to 104°F. Final UPS sizing is the responsibility of the Contractor.

E. The UPS system shall be lightning and surge tested per ANSI/IEEE C62.41 and shall be capable of reducing an input spike to less than 3 volts on the output for a 2000 to 1 spike attenuation. The UPS system shall have 120 dB common mode and 60 dB Transverse mode noise attenuation.

F. The UPS system shall provide a true separately derived power source as defined in the NEC article 250.30 with output neutral bonded to ground. There shall be no direct connection between input and output and less than 23 pf of effective input to output capacitance.

G. The system input voltage shall be 120 VAC, 60 Hz, single phase. Provide external break before make disconnect switch to allow transition to like power for testing or removal of the UPS.

H. The UPS system output shall be regulated to 120VAC ± 3%, single phase three wire, 60 HZ ± 0.5 HZ over the full dynamic range from no load to full load and low line VAC to high line VAC and low battery voltage to high battery voltage.

I. The UPS system shall provide computer grade sine wave power with 5 percent or less total harmonic distortion.

J. The UPS system capacity shall be rated in volt amperes (VA) while loaded with typical computer grade switch mode power supplies having a power factor of 0.6 to 0.7 and crest factor of 2.7 to 3.5.

K. The UPS system shall have an efficiency of at least 92% when operated from AC line.

L. The UPS system shall have built-in self-diagnostic monitoring capable of monitoring as a minimum AC volts in/out, AC current in/out, battery voltage, VA load, watts, power factor percent of full load, time of day, system hours, inverter hours and projected run time available. Unit shall have relay contacts that close to indicate that the UPS is running on battery power, the UPS battery capacity is running low and the UPS has failed or overloaded.

M. The UPS system shall have a dual track redundant configuration that utilizes either line or inverter output for power and shall be designed to meet or exceed a MTBF of 100,000 hours

N. The system input voltage shall be 120 VAC, 60 Hz, single phase. Provide external break before make disconnect switch to allow transition to like power for testing or removal of the UPS.

O. Provide hardwired input and output connections or as a minimum provide L5-30P input connection and (4) 5-20R output connections on a 3KVA unit. If larger unit is required, Contractor is responsible for determining input and output configuration to meet application needs.

P. The UPS shall be designed with internal batteries and with the capabilities of adding external batteries to meet power ride-thru requirements. The batteries shall be sealed, no maintenance type rated to provide minimum continuous operation of connected equipment as specified herein.

Q. The Contractor shall provide sizing data on the UPS listing all loads and calculations required for sizing the UPS system. As a minimum a 3 KVA unit shall be provided.

R. A maintenance bypass switch shall be provided which shall allow for manual transfer of connected load to utility power permitting scheduled maintenance or UPS replacement without discontinuing power to the control panel. The electrical rating and capacity of the bypass switch shall match that of the UPS. Refer to the Plans for additional details regarding the wiring configuration between the UPS and Control panel.

S. The UPS system shall be as manufactured by Liebert, Oneac, MGE or approved Engineer's equal with output relay card, and extra battery module, if required.

T. The maintenance bypass switch shall be the Liebert MicroPOD or approved Engineer's equal.

## 2.9 DIRECT ACTING FLOAT SWITCHES

A. Manufacturers:

1. The float switches shall be Model 9G-EF floats as manufactured by Siemens Water Technologies, Control Systems Products

2. Engineer approved equal.

B. Features:

1. Provide required mounting accessories as detailed on the Plans. The floats shall sense water levels as shown on the Plans. The float shall contain a switch which closes or opens its contacts when floating in a horizontal position. Float switch shall not contain Mercury. Float switches shall be suitable for Class 1 Division 2 locations. Provide intrinsically safe barriers as required.

2. Float switch body shall be constructed of Teflon-coated, 20 gauge, 316 stainless steel housing measuring not less than 51/2" (14 cm) in diameter. A long life, high reliability, potted SPST magnetic reed switch rated for not less than 100 VA at up to 250 Volts shall be mounted inside the float and connected to a multi-stranded, 2 conductor plus ground, 16 gauge, CPE jacketed cable. The cord shall have fine strand conductors (not more than 34 gauge) made especially for heavy flexing service. The cable connection point shall be potted in epoxy providing a strong bond to the float and reed switch forming a water/moisture tight connection. A flexible Neoprene sleeve, not less than 1/8" (3.2 mm) thick, shall be provided over the CPE jacketed cable extending not less than 5" (12.7 cm) from the top of the mounting bracket extending down through the cable mounting bracket hinge point to the top of the float switch body, providing cable stress point relief and extended operational life. Heavier gauge cable shall be provided as required to account for voltage drop considerations.

3. A 316 stainless steel flanged cable mounting clamp assembly shall be supplied allowing pipe or cable mounting as specified below. The float cable-mounting bracket shall be flared on both sides providing hinge point stress relief to both sides of the cable.

4. The float switch assembly shall provide a minimum of two pounds of buoyancy in solutions with a specific gravity of 1.0 (water) and shall have an operating temperature rating of-31 to 194 degrees F (-35 to +90 degrees C).

5. Each float shall be provided with sufficient length of cable to allow a direct connection to the junction box or the SCADA panel without field splicing as detailed on the Plans.

## 2.10 DEERPATH ROAD PAVEMENT FLOODED ALARM SYSTEM

A. A single direct acting float switch shall be mounted in a control cabinet and mounted near the low point of the pavement for detecting water on Deerpath Road. Refer to the Electrical Plans for location of the control cabinet and additional details.

B. Refer to the DIRECT ACTING FLOAT SWITCHED section of this Specification for float switch requirements.

C. The float switch shall be interfaced with SCADA Panel SP38 located in the Pump Station Electrical Room.

D. The SCADA system will monitor the status of the float switch and provide an alarm when flood conditions are detected.

## 2.11 WET WELL FLOAT CONTROL SYSTEM

A. The float control system shall include floats, interconnecting integral cable of a length required, and control logic for the functions indicated.

B. Refer to the DIRECT ACTING FLOAT SWITCHES section of this Specification for float switch requirements.

C. The system shall be intrinsically safe for installation in the wet well.

D. The system shall be complete with control logic to provide the contacts for controls and alarm functions indicated.

E. The system shall be complete with all required mounting hardware and accessories.

F. The float system shall be complete with mounting arrangement with a stilling well of adequate size to forestall the attachment of large sections of ice to the floats during cold weather which could then disturb the system mounting. The mounting arrangement shall permit easy removal of the floats and easy realignment when replaced. Submit details for approval by the Engineer prior to installation.

## 2.12 METAL BAR RACK DIFFERENTIAL LEVEL SENSING SYSTEM

A. Two (2) ultrasonic level sensors (LE-007A/LIT-007A and LE-007B/LIT-007B) shall be used to measure water level. Refer to the ULTRASONIC TYPE LEVELS SENSING

SYSTEM Section of this Specification for details regarding the level sensors. LE-007A/LIT-007A shall be mounted upstream of the Metal bar rack and LE-007B/LIT-007B shall be mounted downstream of the Metal bar rack. Refer to the Plans for additional details regarding the location and mounting requirements for the sensors. A 4-20mA signal proportional to water level shall be produced by each level indicating transmitter and those signals shall be fed to Programmable Logic Controller PLC-SP38. The PLC shall calculate the differential level between the two signals. The PLC shall provide a 4-20mA output proportional to the differential level which shall be fed to a meter mounted on the SCADA panel. The PLC shall be programmed to take into account the level offset in the difference in the mounting height of the transducers. The PLC shall provide an alarm when the differential level becomes to great indicating that the metal bar rack has become clogged. The differential level for this alarm shall be programmable by the operator via the GIP panel mounted on the SCADA panel.

## 2.13 HYDROSTATIC TYPE LEVEL SENSING SYSTEM

A. The hydrostatic type level transmitter shall include an upper and a lower assembly. The lower assembly shall include housing and gauge pressure diaphragm type transducer as specified herein.

B. The hydrostatic type level transmitter upper assembly shall be installed in the Electrical Room and shall house the system signal conditioning and transient protective electronics and connections terminal block. A desiccant type or expansion bag type breathing system shall be installed. A labyrinth seal vent shall be provided on the side to allow atmospheric pressure access to the breathing system. The Upper assembly shall be housed in a NEMA 4 enclosure. A meter assembly shall be provided on the front of the panel for system readout and programming. A 4-20 mA scalable isolated analog output signal proportional to Wet Well water level shall be provided for integration into the SCADA system. The input voltage to the assembly shall be 120 VAC, 60 Hz, 1 Phase.

C. The Connecting Cable between Lower and Upper Assemblies shall consist of ½" O.D., B.F. Goodrich Estane polyurethane jacket, a 3-conductor shielded AWG #16 cable and an integral breather tube which shall form the sealed breathing system between the expansion bag and the Lower Assembly.

D. The liquid level transmitter shall be a 4-20 mADC, 2-wire, 15-40 VDC loop powered type with its output signal directly proportional to the measured level excursion over a factory-calibrated range of zero to 15 ft. of water. The transducer shall be of the solid state head-pressure sensing type, suitable for continuous submergence and operation.

E. The transducer housing shall be fabricated of type 316 stainless steel with a bottom diaphragm 2-5/8" diameter of heavy-duty, limp, foul-free, molded Teflon bonded to a synthetic rubber back/seal. A hydraulic fill liquid behind the diaphragm shall transmit the sensed pressure to a solid STATE variable capacitance transducer element to convert the sensed pressure to a corresponding electrical value. The sensed media shall exert its pressure against the diaphragm which flexes minutely so as to vary the proximity between an internal ceramic diaphragm and a ceramic substrate to vary the capacitance of an electrical field created between two surfaces. A stable, hybrid, operational amplifier assembly shall be incorporated in the transducer to excite and demodulate the sensing mechanism. The transducer shall incorporate laser-trimmed, temperature compensation

and high quality components and construction to provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory calibrated range.

F. The transducer element shall incorporate high over-pressure protection and be designed to withstand intermittent overpressures five times the full scale range being sensed. Metallic diaphragms and sensing principles employing LVDT's, resistive or pneumatic elements are not considered equal.

G. The transmitter shall include easily accessible zero and span adjustments in the upper assembly. +20% zero and 3 to 100% span adjustment shall be provided, using potentiometer and dip switches. Zero and span adjustments shall be non-interactive for ease of calibration.

H. The internal pressure of the lower transducer assembly shall be relieved to atmospheric pressure through a heavy duty urethane jacketed hose/cable assembly and a slack PVC bellows mounted in the Upper Assembly. The sealed breather system shall compensate for variations in barometric pressure and expansion and contraction of air due to temperature changes and altitude as well as prevent fouling from moisture and other corrosive elements.

I. The level transmitter shall be intrinsically safe or an intrinsically safe barrier shall be provided for mounting in the control panel.

J. The level transmitter shall be mounted as indicated on Plans.

K. The level transmitter shall be manufactured by Ametek, Druck, Endress Hauser, or approved equal.

## 2.14 ULTRASONIC TYPE LEVEL SENSING

A. Manufacturer:

1. Siemens Sitrans LUT 420
2. Endress Hauser Prosonics FMU90
3. Or Engineer’s Approved Equal.

B. Transmitter

1. 120 Vac power supply
2. Ambient temperatures: -4℉ to +122℉
3. Shall have local lcd with bar graph indication
4. One isolated 4-20 mAdc, output
5. One form C and two form A output contacts
6. Hand held programmer
7. NEMA type 4x/IP65 enclosure
8. </= 3mm resolution
9. Accuracy: +/- 1mm plus 0.17% distance
10. 10” blanking distance maximum

C. Cable

1. Provide sufficient standard length of manufacturer’s signal cable connecting transducer or junction box without a splice.

D. Measurement requirements:

1. Range of measurement is 0-20 feet

## 2.15 AUTOMATIC TRANSFER SWITCH INTERFACE

A. Refer to Specification Section 26 36 23, AUTOMATIC TRANSFER SWITCHES, for additional details.

## 2.16 FIRE DETECTION AND ALARM INTERFACE

A. Refer to Specification Section 28 35 00, FIRE DETECTION AND ALARM, for additional details.

## 2.17 COMBUSTIBLE GAS DETECTION SYSTEM INTERFACE

A. Refer to Specification Section 28 35 10, COMBUSTIBLE GAS DETECTION SYSTEM, for additional details.

## 2.18 SUMP PUMP SYSTEM INTERFACE

A. Refer to Specification Section 43 21 43, SUMP PUMPS, for additional details.

## 2.19 PILOT DEVICES AND CONTROL STATION COMPONENTS

A. Manufacturers:

1. Allen Bradley 800T.
2. Square D Class 9001, Type K.
3. Cutler-Hammer 10250T.

B. Construction

1. Heavy duty.
2. Watertight.
3. Oil-tight.
4. Flush panel mounting
5. Size to mount in 30.5-mm diameter.
6. Match NEMA rating of associated Control Station (see below)

C. Pushbuttons:

1. Flush head unless specified elsewhere.

2. Contact Blocks:

a. Double break silver contacts.
b. Ac Ratings: 7,200 va make, 720 via break.
c. Single pole, double throw or double pole, single throw.
d. Up to six tandem blocks.
e. Momentary contact unless specified elsewhere.
f. Non-illuminated.

g. Legend plates, as required, for type of operation or as specified elsewhere.

D. Pushbuttons – Emergency Stop (ESTOP)

1. Jumbo red mushroom head.

2. Contact Blocks:

a. Double break silver contacts.
b. Ac Ratings: 7,200 via make, 720 via break.
c. Single pole, single throw.
d. Up to six tandem blocks as specified.

1. Push/pull.

2. Maintained contact.

3. Non-illuminated.

4. Legend plates:

a. Extra large.
b. Red.
c. “ESTOP”.

E. Selector Switches:

1. Maintained position unless specified elsewhere.

2. Contact Blocks:

a. Double break silver contacts.
b. Ac Ratings: 7,200 via make, 720 via break.
c. Contact configuration as specified.
d. Up to six tandem blocks.

3. Operators:

a. Number of positions as specified elsewhere.
b. Standard knob type unless specified elsewhere.

4. Legend plates as required for type of operation or specified elsewhere.

F. Pilot Lights:

1. Transformer type.

2. Bayonet, 6 to 8 v bulb.

3. Colored lens as specified elsewhere.

4. Interchangeable lenses.

5. Transformer rated for 120 v, 60 Hz.

6. Push to test.

7. Legend plates as specified elsewhere.

G. Control Stations:

1. Describes enclosures used to house field pilot devices.

2. NEMA ratings:

a. NEMA 7 in Class 1, Division 1 or 2 Hazardous (Classified) Locations.
b. NEMA 4X 316 stainless steel in indoor wet/corrosive locations or outdoors.
c. NEMA 12 in other areas.

3. Nameplates:

a. Engraved laminated plastic.
b. Letters 3/165 in. high.
c. Black letters on white background.
d. Identify per equipment controlled, using names found on Plans.

## 2.20 PROCESS INDICATORS, ELECTRONIC

A. Manufacturers:

1. Precision Digital.
2. Red Lion, IMP.
3. Moore Industries.

B. Features:

1. 4-20mA dc Input.
2. ½ digit LED indicator.
3. Loop powered.

C. Enclosures:

1. Panel mounted as indicated on Plans.

2. For below grade or outdoor installations: NEMA 4X: Impact-resistant polycarbonate body, clear gasketed polycarbonate cover ½" conduit hole in bottom of case.

3. For Explosion Proof installations: NEMA 7 XP: FM approved cast aluminum body, screw-type cast aluminum cover with view port. Two ¾" conduit holes.

4. Provide 2" pipe mounting kit as detailed.

D. Model: PD675-N, NEMA 4X; PD677-N, NEMA 7 XP.

## 2.21 TEMPERATURE SWITCHES – BUILDING STATUS

A. Manufacturers:

1. Honeywell.
2. Or engineer's approved equal

B. Features:

1. Integral temperature indicator.
2. Suitable for wall or ceiling mount.
3. Adjustable high and low temperature setpoints.
4. Dry contacts suitable for connection to PLC Reed Relay input.

## 2.22 TEMPERATURE SENSORS/TRANSMITTERS

A. Manufacturers:

1. Minco
2. Siemens
3. Honeywell
4. Engineer's approved equal

B. Features:

1. Temperature Sensor/transmitter shall be suitable for temperature ranges between -20 to 125 Degree F.

2. Transmitter shall have 4-20 mA output proportional to ambient temperature and shall be integrated into the SCADA system.

3. Temperature Sensor/transmitter for Electrical Room shall be wall mounted and housed in a NEMA 1 Enclosure.

4. Temperature Sensor/transmitter for Electrical Room shall be wall mounted and housed in an Explosion Proof Enclosure.

5. Units shall be UL Listed.

## 2.23 CONTROL RELAYS

A. Manufacturers:

1. Potter and Brumfield

2. Struthers Dunn.

B. Operating Data:

1. Pickup Time: 13 ms maximum.
2. Dropout Time: 10 ms maximum.
3. Operating Temperature: - 45ºF to 150ºF.

C. AC Coil:

1. 120 or 2409 vac.
2. Continuous rated.
3. VA inrush maximum.
4. VA sealed, maximum.
5. 50 to 60 Hz.
6. Light to indicate energization
7. Minimum Dropout Voltage: 10% of coil rated voltage.

D. DC Coil:

1. 24 or 120 Vdc.
2. Continuous rated.
3. Light to indicate energization.
4. Minimum Coil Resistance:
5. 24 Vdc: 450 Ω.
6. 120 Vdc: 9,000 Ω.

E. Contacts:

1. Gold flashed fine silver, gold diffused for 1 amp or less resistive load.
2. Silver cadmium oxide.
3. form C.
4. 120 vac.
5. 10 amp make, 1.5 amp break (inductive).
6. Rated at 10 million operations.
7. 11 pin, square socket.

8. DIN rail mountable.

9. Enclosed and protected by polycarbonate cover

10. Provide relay-retaining clips.

## 2.24 TIMERS

A. Interval/Duration Timer (Rear of Panel):

1. Manufacturers:

a. Potter and Brumfield, CN series.
b. Eagle Signal DM 100 series.
c. Or equal.

2. Mounting: Plug-in with dust tight cover.

3. Type: Integrated circuit.

4. Range: 0.5 sec to 99 min. Field selectable.

5. Contacts: 2 DPDT contacts rated 10 amp. 120 vac.

6. Power: 120 vac, 60 Hz.

B. Interval/Duration Timer (Front of Panel):

1. Manufacturers:

2. Eagle Signal, CX300 series.

3. Or equal.

4. Type: Microprocessor.

5. Timing Range: Five ranges from 200 sec to 200-hr field selectable.

6. Contacts: 10 amp, 120 vac.

7. Controls: Membrane switches for operator input.

## 2.25 TERMINAL BLOCKS

A. Manufacturers:

1. Phoenix Contact.

2. Weidmuller.

3. Or equal.

B. 300 v rating for 120 v circuits and below, 600 v rating for 480 v circuits.

C. Clamping screw type.

D. Isolating end caps for each terminal.

E. Identification on both terminals.

F. Clip-mounted on DIN rail.

G. Accept AWG 12 to 22.

H. Feed-Through Terminals:

1. 20 Amp rating.

I. Switched Terminals:

1. Knife disconnect with test sockets.

2. 10 Amp rating.

J. Fused Terminals:

1. Hinged fuse removal/disconnect.

2. 10 Amp rating.

3. Include blown fuse indication.

## 2.26 ELECTRONIC CURRENT ISOLATOR

A. Manufacturers:

1. Phoenix Contact Model MCR Series.

2. Approved Engineer’s equal.

B. Features

1. Solid state instrument to electrically isolate one instrument loop from another instrument loop. Converter to accept 4-20mA dc input signal and provide equal but isolated and power-boosted output.

2. Mounting: DIN Rail.

3. Temperature compensated, calibration-free.

4. Signals: Input: 4-20mA dc into 50 ohms. Output: 4-20mA dc into output for up to 500 ohms.

5. Isolation: Common mode up to 700 vac between input and output.

6. Accuracy: 0.5% of span.

7. Provide power supply specific to isolator.

## 2.27 INTRINSICALLY SAFE BARRIERS AND RELAYS

A. Manufacturers:

1. Gems Safe-Pak or Engineer's approved equal

B. Provide intrinsically single channel safe barriers, dual channel safe barriers and relays as indicated on the Plans and as required to meet NEC requirements for explosion proof applications. All wiring between those rooms identified as Hazardous Locations and Non-Hazardous locations shall be provided with intrinsically safe barrier or relay as the installation calls for.

C. Provide relays with 2NO/2NO auxiliary contacts or as indicated on the Plans. Provide additional contacts as required to meet installation requirements.

## 2.28 SCADA PANEL FABRICATION

A. General

1. Refer to Plans for additional details.

2. The panels shall match the general construction of the motor control center and shall be of the same height.

3. The panels shall conform to all application standards of NEMA and ANSI and shall consist of formed steel panels containing equipment and devices as indicated.

4. The panels shall be equipped with space heater(s) as specified for motor control centers.

B. Enclosure

1. The SCADA panel shall be NEMA 12 floor mounted, front accessible only, metal enclosed type, arranged for cable and/or conduit entry from the top, bottom or sides, as required. Panel design shall allow easy access to all internal wiring and appurtenances. Ventilation fan, air filter, thermostatically controlled space heater, light kit and 120V receptacle shall be provided.

2. The enclosure shall be of a height and depth to match the motor control center and of a width sufficient for the equipment to be housed.

3. The panel shall have a full piano hinge door and a 3-point latch with a locking handle. The handle shall have a cylinder type lock keyed to match the owner's system. The doors shall have gasketed doors.

4. The enclosure shall be finished inside and out. Exterior color shall match that for the motor control center, and the interior color shall be white or as otherwise approved by the Engineer.

C. Devices and Appurtenances

1. Unless otherwise indicated, pushbuttons, selector switches, indicating lights, relays, and other devices shall be provided as part of the control panel and shall be as specified for motor control centers. Devices similar by those in he motor control center panel shall be of the same manufacturer.

2. Where indicated, certain devices shall be furnished under other Sections of the Specifications for installation under this Section. The control panel manufacturer shall coordinate the arrangement and wiring of these devices for a complete finish assembly. Such devices shall be factory installed by the panel manufacturer.

3. Nameplates shall be white with black lettering and consistent on all panels and devices. Relays and all other devices located inside the panel shall be identified with nameplates.

D. Wiring

1. Wiring shall be brought to terminal strips near the bottom of enclosures and 10 percent spare terminals shall be provided in each. The identification of terminals shall conform to the schematic diagrams and shall consist of adhesive labels as manufactured by Brady, Thomas, or equal.

## 2.29 CONTROL DEVICES AND WIRING

A. Control devices, local instrument cables and wiring required on the equipment shall be furnished and installed at the factory.

B. All small wiring for control or accessory equipment shall be installed in code approved wireways.

C. Wiring Conventions

1. All wiring shall be of the following minimum.
   a. Power wiring to power PLC power supply shall be #12 AWG MTW. PLC chassis shall be connected to the enclosure ground bus with #8 AWG MTW.
   b. Panel doors shall be connected to the enclosure ground bus with #8 AWG MTW
   c. Single conductor I/O control wiring that is connected to 120VAC control circuits shall be No. 12 AWG MTW, minimum. Single conductor I/O control wiring that is not connected to 120VAC circuits shall be No. 14 AWG MTW, minimum. The conductor shall be stranded copper for fixed wiring and extra flexible copper for wiring to components that are mounted to a movable surface, i.e. doors or hinged panels. The extra flexible conductors shall have

600 volts, 90 Degree C, polyvinyl chloride insulation with flameproof braid covering, Type TBS or cross-linked polyethylene, Type SIS. The conductor type for fixed mounted components shall be type THHN/THWN, 600 volt, 90 Degree C.

D. Cabling

1. For indoor, Non-Plenum applications analog I/O shall be wired with Belden 8760 or equivalent, single twisted pair, shielded cable. For outdoor and Plenum applications analog I/O shall be wired with Belden 88760 or equivalent, single twisted pair, shielded cable. The drain-wire from each cable shall be connected an isolated ground bus. All shields shall be covered with clear Teflon tubing. The black conductor shall carry the positive signal (+) and the clear conductor shall carry the negative signal (-)
2. Remote I/O (R I/O) communications circuits shall be wired with Belden 9463 or equivalent, twin-axial, shielded cable. Communications wiring shall cross AC conductors at a 90-degree angle. Where communication wiring must run parallel to AC conductors, a minimum of 2" separation must be maintained.
3. All wires and cables that enter or leave the control panel must terminate at a terminal.

## 2.30 WIRELESS MODEM

A. Manufacturers
1. Sierra, no substitutions allowed.

B. The two (2) wireless 4G modems are to be Sierra Wireless FX30 LTE series modems. Contractor shall verify, prior to purchase, compatibility with the City of Lake Forest's and the SCADA communications systems.

# PART 3 - EXECUTION

## 3.1 INSPECTION

A. Verify that field conditions are acceptable and are ready to receive work.

## 3.2 INSTALLATION

A. The modification, demolition and installation of the SCADA equipment shall be scheduled to minimize interruption of automatic operation and monitoring of the pumping system. The contractor shall submit a detailed schedule for the owner's approval

B. The Contractor shall install the equipment in strict accordance with the approved Shop Drawings and the equipment manufacturer's recommendations

C. Unload, unpack and transport equipment to prevent damage or loss.

D. Protect from dust and other harmful materials

1. The Contractor shall adjust the location of equipment to accommodate the work in accordance with field conditions encountered.

2. The equipment shall be installed with workspace clearances required by the Code.

3. The equipment shall be installed to permit maintenance and replacement of parts, and shall be clear of all openings with swinging or moving doors, partitions or access panels.

4. Mounting Bases for Floor Mounted SCADA panel.

5. The Contractor shall install each floor mounted panel on a concrete housekeeping pad of sufficient with an apron as indicated on the Plans. SCADA Panel SP38 shall be mounted opposite of the MCC in the Electrical Room. Housekeeping pad shall be consistent for all equipment mounted adjacent to one another. The equipment shall be of such construction that when it is installed on the concrete pad there are no openings between the top of the pad and the bottom of the equipment.

6. Each foundation shall be level, stable, and compacted to 95 percent Standard Proctor.

7. Entryways or conduit locations shall be in accordance with manufacturer's approved Shop Drawings.

8. Wall Mounted Control panels

   a. Each wall mounted control panel shall be supported and mounted away from the wall with "C" shaped channel. The minimum separation between the equipment and the wall shall be 1 inch.

   b. Each control panel shall be mounted with the top a maximum of 6' - 6" above the finished floor

E. Install in accordance with manufacturer’s instructions.

F. Replace damaged components as directed by Engineer.

G. Provide all required cables, cords, and connective devices for interface with other control system components.

H. Field signal wiring and cables under this SECTION shall be installed in conduit.

## 3.3 INSTALLATION OF INTRINSICALLY SAFE BARRIERS AND RELAYS

A. Field wiring of intrinsically safe circuits is to be segregated from non-intrinsically safe wiring by use of suitable barriers, separate wireways or trays. Wire insulation to be .010" minimum.

B. Intrinsically safe and non-intrinsically safe connection points should be located sufficiently apart to prevent any possibility of bypassing or miswiring during installation or servicing of equipment.

C. The enclosure shall contain a cautionary statement as follows: "CAUTION: ANY SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY".

D. The device mounting bracket must be grounded to insure intrinsic safety. Resistance between bracket and ground electrode should be below one ohm. Refer to Article 250 of the National Electrical Code for methods and practices.

E. Non-intrinsically safe wiring cannot be run in conduit or open raceways together with intrinsically safe wiring.

## 3.4 PLC PROGRAM SOFTWARE AND GIP GRAPHICAL SCREEN DEVELOPMENT PHASE

A. PLC software programming and GIP graphical screen development meetings must be conducted with the owner to ensure all operational and maintenance requirements are met. The following meetings are required:

1. Meeting No. 1 – Design Review

   a. Meeting No. 1 is to be conducted at the owner's location. A minimum of (1) 8-hour day must be allotted for this meeting.

   b. The meeting is to include, but not limited to the following:

      1) The owner's presentation of standardized PLC software programming elements
      2) An overview presentation of the manufacturer's GIP graphical screens
      3) Detailed overview of SCADA and control requirements
      4) Detailed overview of operational requirements
      5) Detailed overview of proposed facility requirements

2. The owner will provide CAD drawings of the project for use in GIP Screen development.

3. The owner will provide electronic copy of programming software of standardized elements for the Contractor to use as a base in his software development.

4. The meeting must produce the following documents to aid the GIP screen software development:

   a. A detailed list of GIP screens that are to be developed

   b. A written description of each that is to be developed

   c. A general color scheme for graphics

   d. Meeting minutes

5. Meeting No. 2 – 35% Design Completion

    a. Meeting No. 2 is to be conducted at the owner's location. A minimum of one (1) eight-hour day must be allotted for this meeting.

    b. Contractor must review all requirements discussed with the owner during Meeting No. 1.

    c. The Contractor must present the preliminary PLC software programming. The owner will provide comments regarding the presented material for incorporation into the PLC programming design. The requirements for Contractor's 90% Design Completion are to be established

    d. The Contractor must present the preliminary GIP screen graphics. The owner will provide comments regarding the presented material for incorporation into the GIP design. The requirements for Contractor's 90% Design Completion are to be established.

6. Meeting No. 3 – 90% Design Completion

    a. Meeting No. 3 is to be conducted at the owner's location. A minimum of 4 hours must be allotted for this meeting.

    b. Contractor must incorporate all required changes requested by the owner during Meeting No. 2.

    c. The level of completion must meet the 90% design requirements established at Meeting No. 2.

    d. The Contractor must present a demonstration of the actual software operation to the owner. A minimum of eight copies of the CD containing the software programming as presented in the meeting must be provided to the owner. The owner will review the information and provide written comments to the Contractor.

    e. The Contractor must present a demonstration of the actual operation of GIP graphics to the owner. A minimum of eight copies of the CD containing the GIP graphical screens as presented in the meeting must be provided to the client. The client will review the information and provide written comments to the Contractor.

7. Meeting No. 4

    a. Meeting 4 is to be conducted during Factory Acceptance Testing as detailed below.

    b. Contractor must incorporate all required changes requested by the client during Meeting No. 3.

    c. The final executable version of the PLC software program must be presented. Upon review by the client, minor changes must be allowed during the Factory Acceptance Testing.

d. The final executable version of the GIP screen graphics must be presented. Upon review by the client, minor changes must be allowed during the Factory Acceptance Testing.

e. Contractor must provide detailed minutes of meeting to all individuals whom attended the meetings.

## 3.5 FACTORY ACCEPTANCE TESTING (FAT)

A. The assembled control equipment, wiring and connections shall be tested in the factory. A full functional test shall be applied to each panel. The manufacturer shall demonstrate to the client that each panel and/or group of panels properly function as designed and accepted.

1. The Contractor shall be able to simulate the SCADA system within his facility. Shop testing shall include, but not necessarily be limited to, the following:

2. Manually fill-in required additions to database

3. Manual forcing of outputs

4. Operation of the control programs

5. Recall of simulated data points on the displays and printers

6. Recall of all reports with partial fill-in data and manual fill-in data at time of testing

7. Routing testing of logger, alarm printer and LCD displays based upon manual input data

8. Change of alarm and limit set points, etc., and observation of results

9. Any additional testing which may be found to be necessary at the time the above is observed.

10. During the Factory Acceptance Test, minor software adjustments must be finalized and incorporated into the final system.

11. All necessary contact and analog inputs must be provided to permit satisfactory testing of the above.

B. The Contractor must provide to the client a Factory Acceptance Test Plan and schedule forty-five (45) days before the scheduled Factory Acceptance Test. IDOT will review the Factory Acceptance Test Plan and schedule for content and reserves the right to make changes. The Contractor must provide the Director a copy of the final Factory Acceptance Test Plan and schedule ten (10) working days before the Factory Acceptance Test. The Contractor will be expected to do all necessary pretrial testing and debugging to ascertain that the system is in running order.

C. At a minimum, the Factory Acceptance Test must allow for two (2) days of testing and review, but may require additional time depending on the results of the testing.

D. IDOT reserves the right to be present for the Factory Acceptance Testing. The Contractor must include the costs of setting up and performing the test including the cost for transportation and lodging for up to two (2) of IDOT's representatives.

E. During shop testing, the Contractor shall generate hard copy prints of all reports and graphics, indexes and point I.D.'s on both printer and LCD monitor for submittal, review and correction. A certified letter that the listed shop tests have been performed shall be submitted. The client reserves the right to be present when shop tests are run.

## 3.6 FIELD QUALITY CONTROL

A. Field Service:

1. The panel equipment manufacturer(s) shall provide a qualified factory trained service engineer to provide technical direction for the installation and final adjustments of the equipment. As a minimum, the following shall be performed:

   a. Inspect wiring, components, connections, and equipment installation.

   b. Assist in field testing of equipment.

   c. Install and test SCADA software.

   d. Install and test SCADA application.

   e. Report results in writing

2. The service engineer shall certify that the equipment has been installed in accordance with the equipment manufacturer's recommendations.

3. The service engineer shall be available for a minimum of two, 8-hour working days.

B. Installation and Start-Up:

1. The Contractor shall develop a specific plan for the startup of the new SCADA system and for cutover of control to the new system. No startup or cutover activities shall be performed until the plan has been successfully approved by the Engineer.

2. Coordinate so that all panels, instrumentation, etc. provided under separate specifications are installed, integrated re ready for field testing.

3. The Contractor shall correct or rectify any deficiencies that are noted during field testing at no additional cost to the client.

## 3.7 SITE ACCEPTANCE TESTING

A. A Site Acceptance Test of the functions, software, and performance shall be conducted after all system elements have been installed and a complete checkout of all I/O points has been completed. The system site tests shall be performed to verify complete operation of the system, requiring a repeat of much of the comprehensive Factory Acceptance Test but with the equipment installed at the permanent sites, and shall include additional tests required to verify field installed equipment, which was not available during the FAT. The SCADA System Provider shall:

1. Verify all the facility installations

2. Demonstrate each functional requirement identified by the specification. This demonstration shall repeat the tests used during FAT, but using real rather than simulated conditions

3. Demonstrate all equipment control functions, including the operation of automatic control strategies. Actuation of field devices shall be closely coordinated with facility operations

4. Verify system performance parameters and system responses under field operational conditions.

5. Verify accuracy of documentation, especially operator’s manuals, software documentation, and general system operating instructions

B. The SCADA System Provider shall provide the appropriate technical representatives for the execution of the Site Acceptance Test. The SCADA System Provider's test support personnel shall be qualified to resolve and correct problems encountered with the system during the tests. In addition to test support personnel, the SCADA System Provider shall provide all test instruments and equipment necessary to troubleshoot any of the SCADA System Provider’s proposed system problems encountered. The Engineer reserves the right to increase the requirements for test support personnel if support by the SCADA System Provider is inadequate.

C. Final Acceptance Testing

1. Satisfactory operation of the work by the client shall be interpreted to mean that the work is sufficiently advanced to form a reliable system for system operation; the I/O control loops, software, control programs and peripheral equipment are operating properly; the necessary debugging programs have been performed; data output is reliable and control loops are operational. Equipment which was found to be ineffective or inoperable has been returned or replaced, and checking and calibrating of systems has been completed.

2. Final acceptance test will be run for 40 days within which cumulative major component down time, consisting of the computer systems and the PLC's, does not exceed 8 hours. Repeat test if 8 hour limit is exceeded.

3. Written acceptance by the client shall be the starting date of the guarantee period.

## 3.8 TRAINING

A. Operational Training

1. Operator training shall be provided at the client's facility concurrently with system installation on a prearranged formalized basis and shall include the necessary training aids in conjunction with actual work on the equipment supplied. Work shall include complete review of all operating and training manuals and physical application.

2. Training shall include operation of the SCADA system, set up the changes of control logic and set points, initiation of diagnostic routine, set up and revisions of graphic and report format, system shutdown and restart, etc. It shall also include care, maintenance and tuning of the monitor and screens.

3. Upon completion of this program, the operators shall be capable of operating the processor equipment, peripherals and I/O equipment to monitor and control the process, system shutdown and restart, diagnose system failure and to initiate routine switch over procedures and component replacement.

4. This training shall consist of a minimum of two (2) 3 day (8 hours per day) classes for 2 persons in each class. Training manuals shall be provided.

B. Programming Training

1. The Contractor shall make arrangement for two persons from the client to attend software manufacturers' regular programming classes held by the manufacturers or their representatives. The class shall not be less than 1 week for SCADA GIP software and 1 week for PLC programming (Allen-Bradley PLC). The training course fee shall be paid for by the Contractor. The manufacturer shall have regular training facilities within 40 miles of the Pumping Station.

C. Maintenance Training

1. The Contractor shall provide two 1-day on-site maintenance training classes for 2 persons in each class. The maintenance training may be combined with the OPERATOR TRAINING.

**END OF SECTION 40 94 23**

**DIVISION 40 – SCADA SYSTEM**

**SECTION 40 94 24 – HMI IMPROVEMENTS**

**PART 1 - GENERAL**

**1.1 SCOPE OF SERVICES**

A. The requirements of the owner shall apply to all SCADA SYSTEM described herein.

B. The proposed Pump Station SCADA System shall be remotely monitored by the owner via cellular modem communications. Currently, Allen Bradley RSView is the Human Machine Interface (HMI) software that is installed at the workstations at these locations and is the means in which the operators monitor the pump stations.

C. The work under this section includes the software development, installation, integration and testing of the HMI screens for the proposed pump station at both locations.

D. Contractor is responsible for all necessary coordination with the the owner required for ensuring the proper functioning of the remote monitoring systems.

**1.2 RELATED SECTION**

A. Section 40 94 23 – SCADA System

**1.4 SUBMITTALS**

A. Submit product data, shop drawings, project documentation, O & M Data and record documents in accordance with the provisions of Section 1A and the following specific information.

B. Copies of the following Product Data shall be provided to the EMC so that the makeup of the SCADA system can be understood and all PLC data points can be identified for development of the HMI software.

1. Bill of Material: List all the materials and equipment to be furnished. Tag number, manufacturer's complete catalog number, service, location, and cross-reference numbers of instruction sheet, specification data sheet and wiring diagram shall be included under each item.

2. Specification Data and Drawings: Furnish instrument specification data sheet as per ISA standard instrument specification form, if applicable, wiring and/or connection diagram, outline dimensions, installation diagram and manufacturer's catalog for each instrument. A common set of drawings with setting and/or scale individually listed may be furnished for instruments with identical specification except setting and/or scale.

C. System Diagrams

1. Instrument Loop Diagram: Show all analog and digital loops for all instrument sensors, secondary instruments, I/O functions, alarms, control and displays using ISA standard symbols per ISA Standard S5.4.

2. SCADA System Block Diagram: Show system hardware configuration and identify model numbers of each system component.

D. Software Documentation

1. Submit system software, application software, graphic pages and report forms in prints. Software, application programs, ladder diagrams and control logics shall also be submitted in 740MB CD-R.

E. Instruction Manuals

1. Submit instruction manuals covering installation, operation, calibration, maintenance, diagnostic and repair for all hardware and software.

F. Record Documents

1. Accurately record actual calibration setting and scales of instruments.

## 1.5 BASIS OF PAYMENT

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, SCADA SYSTEM.

**END OF SECTION 40 94 24**

**DIVISION 41 – MATERIAL PROCESSING & HANDLING EQUIPMENT**

**SECTION 41 22 13 – BRIDGE CRANE**

**PART 1 – GENERAL:**

**1.1 <u>DESCRIPTION.</u>**

A. SCOPE

1. This section specifies bridge cranes and hoisting equipment.

2. Runway beams and rail are part of the building steel package and are not included in this section.

B. CRANE SUMMARY

| | |
|---|---|
| Span: | 11 Ft. |
| Capacity: | 2 Tons |
| Crane type: | Single girder, under running |
| Classification: | Crane shall be designed and constructed to CMAA Specification as applicable, **"Class 1, Division 2, Group D, hazardous location.** |
| Crane speed: | Single Speed |
| Crane drive: | Dual motor drive |
| Trolley speed: | Single Speed |
| Trolley drive: | Motorized |
| Hoist speeds: | Single Speed |
| Hoist type: | Electric wire rope |
| Hoist lift required: | 35 Ft. minimum |
| Control: | Pendant from independent track on bridge |

C. WORK INCLUDES THE FOLLOWING:

1. Detailed design of completed crane system, including bridge, end trucks, trolley, hoists, cabling, controls, and all appurtenances specified hereinafter.

2. Shop drawings.

3. Fabrication of a complete crane.

4. Inspection and shop testing.

5. Documentation and schedules.

**1.2 <u>REFERENCE STANDARDS</u>.**

A. Equipment furnished under this section shall comply in all respects with the requirements of the following standards:

1. OSHA - Occupational Safety and Health Administration: Part 1926.554 - Overhead Hoists, Part 1910.179 – Overhead and Gantry Cranes.

2. CMAA Crane Manufacturer's Association of America:

   a. Specifications for Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist - No. 74 (2004)

3. ANSI / ASME - American National Standards Institute / American Society of Mechanical Engineers

   a. ANSI / ASME HST-4 – 1999 Performance Standard For Overhead Electric Wire Rope Hoists

   b. ANSI / ASME B30.16 – 2007 Overhead Hoists (Underhung)

   c. ANSI / ASME B30.2 - 2011 Overhead and Gantry Cranes (Top Running Bridge, Single Or Multiple Girder, Top Running Trolley Hoist)

   d. ANSI / ASME B30.11 – 2010 Monorails and Underhung Cranes

   e. ANSI / ASME B30.17 – 2006 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)

4. NEMA - National Electric Manufacturer's Association (NEMA 7)

5. NEC - National Electric Code – Latest Edition Article 100, Article 240-1, Article 430-31, Article 430-51, Article 610-1, Article 610-31

## 1.3 SUBMITTALS.

A. SHOP DRAWINGS AND EQUIPMENT DATA

1. Manufacturer's catalog data for hoist.

2. Dimensional drawings and details for bridge crane system.

3. Wiring schematics. – ship with crane

B. OPERATIONS AND MAINTENANCE MANUALS (one set of Owner's manuals in paper and on CD rom)

1. Equipment function, normal operating characteristics, and limiting conditions.

2. Assembly, installation, alignment, and maintenance instructions.

3. Lubrication and maintenance instructions.

4. Guide to "troubleshooting".

5. Parts list.

6. As-built drawing.

7. Test results.

**1.4 APPLICABLE STANDARDS.**

A. Contractor shall adhere to OSHA, state, and local safety guidelines, laws, rules, and regulations.

B. Contractor shall conform to all applicable ANSI, CMAA, and HMI specifications and/or standards.

C. Comply with CMAA specifications, as applicable.

D. Long lead items include hoist, end trucks, drives and controls. Steel will not be ordered until shop drawings and submittals have been approved by the A/E.

E. All electric equipment shall be UL labeled.

**1.5 WARRANTIES.**

A. Provide one-year equipment warranty

**1.6 BASIS OF PAYMENT.**

A. Payment for the work specified under this Section and as required shall be included in the Contract lump sum price for the Item, BRIDGE CRANE.

**PART 2 – PRODUCTS:**

**2.1 MANUFACTURERS.**

A. Bridge crane package systems shall be provided by:

1. CM HOIST – YALE
2. ACCO WRIGHT
3. DETROIT HOIST

B. Hoist shall be Yale Americas electric wire rope type or approved equal.

1. CM HOIST – YALE
2. ACCO WRIGHT
3. DETROIT HOIST

**2.2 MATERIALS.**

Components Material

| | |
|---|---|
| Runway Beams | Steel, ASTM A36 or A992 |
| Bridge beams | Steel, ASTM A36 or A992 |
| End trucks | Steel, ASTM A36 (or equal) |
| Trolley | Steel, ASTM A36 (or equal) |
| Wheels | Bronze – spark resistant |
| Hooks | Forged steel |

## 2.3 EQUIPMENT.

A. HOIST AND TROLLEY

Hoisting motor(s) shall be totally enclosed with protection and minimum insulation meeting requirements for Class 1, Division 2, Group D hazarhous locations Klixon type bimetal switch for thermal protection.

1. The hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 110% of the rated load.

2. Hoist and trolley motors shall be per 1.1B above, as applicable.

3. Hoisting motor(s) shall be single speed.

4. Trolley shall be furnished with an single speed control for smooth operation.

5. Trolley motors shall be inverter duty motors with minimum insulation and motor enclosures to meet the requirements listed above.

6. Rotary cam type limit switch equipped with 4 micro-switches shall be provided. Limit switch shall provide upper and lower limit of hoist travel, hoist slow down prior to reaching upper limit and phase sequence supervision at upper limit. An additional block operated limit shall be included.

7. Hoist motor brake shall be DC disc type with adequate torque to stop and hold over **125%** of the hoist rated load.

8. Large diameter rope drum with a minimum of 36:1 drum to wire rope diameter ratio. Groove depth shall be at least 35% of rope diameter. The rope drum shall be equipped with a rope guide to help keep the rope aligned in the grooves of the drum.

9. Wire rope shall be constructed from stainless steel having a minimum safety factor of 5.

10. Hoist reeving shall be double reeved. Lateral hook drift shall not exceed 1/8 inch per foot of vertical travel on double reeved models.

11. The hoist nameplate is to carry a US rating. The actual hoist control enclosure rating shall be at least equivalent to NEMA 7 type.

12. Hooks shall be made of forged alloy steel and shall be fitted with a spring-loaded flipper-type safety latch. (Spark Resistent)

13. Hoist shall have a duty rating suitable for the load class and load cycles of the application.

14. AGMA quality class 12 machine cut, hardened and precision ground hoist gearing. The gears inside the hoist gearboxes on models up to 5 ton capacity are lubricated by semi-fluid grease. On models over 5 ton capacity the gears inside the hoist gearbox are lubricated with semi-fluid grease or oil.

15. AGMA quality class 10, hardened and precision ground trolley drive gearing, lubricated by semi-fluid grease.

16. Trolleys shall have safety drop lugs and energy absorbing bumpers.

B. RUNWAY BEAM

1. Runway Beam shall be designed and provided by the Bridge Crane Manufacturer per 1.1B above.

2. Runway beams and Bridge girders shall be constructed from welded box girders or Structural beams, Steel, ASTM A36 or A992, as required.

C. END TRUCKS AND BRIDGE DRIVE

1. End trucks shall be designed in accordance with CMAA specifications as applicable.

2. End trucks shall be bolted to runway beam.

3. Bridge drive shall be dual-motor (A-4 arrangement per CMAA).

4. Bridge drive shall be designed to stop the bridge within CMAA specifications.

5. End trucks shall be equipped with rail sweeps and energy-absorbing rubber bumpers.

6. Travel limit switches to be provided as necessary for safe operation.

7. Bridge shall be furnished with a single speed control for smooth operation.

8. Bridge motors shall be inverter duty motors with minimum insulation and motor enclosures to meet the requirements of Class 1, Division 2, Group D, hazardous locations.

9. AGMA quality class 10, hardened and precision ground bridge drive gearing, lubricated by semi-fluid grease.

D. POWER SUPPLY

1. Power supply for the hoist shall be 480 volt, 3 ph., 60 Hz. All power required for the operation of the hoist, trolley, and end trucks shall be developed from this source and meet NEMA 7 requirements.

2. Runway electrification shall be 4-bar safety type rigid conductors as manufactured by Insul-8, Duct-O-Wire Company or Wampfler and meet NEMA 7 requirements.. Wall mounted disconnect switch and power to runway conductors provided by Electrical Contractor.

3. Cross bridge electrification shall be flat cable style festoon system with terminal box, multi-conductor cord, plug connectors (when available) and accessories and meet NEMA 7 requirements.. Cables are to be hardwired when plug connectors are not available.

E. CONTROLS

1. The following controls shall be used as applicable:

   a. Six-way operation, plug-in pushbutton pendant suspended from independent festoon track.

   b. Pendant shall include Start (momentary) button and Emergency Stop (push to maintain, turn to release) that controls a mainline contactor in the bridge control panel.

   c. Pushbutton shall be clearly marked with hoist, trolley and bridge travel directions.

   d. Hoist shall be 2 speed magnetic reversing type (standard) and the trolley and bridge controls shall be variable frequency inverter control (standard), as required per section 1.01.B.

   e. Electrical control enclosures shall be NEMA 7 type. Pushbutton enclosure shall have a rating of NEMA 7.

F. LABELING

1. Hoist and bridge beam shall be labeled with load rating.

2. A corrosion-resistant nameplate shall be fixed to the bridge with the following information:

   a. Name of manufacturer
   b. Mfg.’s model number and serial number
   c. Capacity
   d. Date of manufacture (month and year)

G. PAINTING

1. Hoist and trolley shall be factory painted (2-part epoxy) per manufacturer’s standards.

2. Bridge shall be shop cleaned, primed, and painted per manufacturer’s standards.

3. The following items shall not be painted:

a. Rail surfaces in contact with wheels
b. Wheel running surfaces
c. Hoist wire rope
d. Conductor bar, festoon cables and supports

**PART 3 – EXECUTION:**

**3.1 INSTALLATION AND INSPECTION.**

A. Inspect structure and crane rail erection for conformance with reviewed shop drawings and contract documents prior to installation of equipment. Bring nonconforming work to the attention of the customer prior to proceeding with crane installation. Non-conforming runway structure or installation must be corrected prior to load testing of crane system. Costs of delays or additional work due to nonconforming runway structure will be reimbursed by the Owner.

B. Bridge crane shall be installed in conformance with manufacturer's instructions and inspected by a manufacturer's representative. Provide all necessary accessories to make bridge crane complete, usable, and capable of meeting the operating requirements specified in the Operating Requirements. Test, adjust and clean equipment for acceptance by Owner.

**3.2 TESTING.**

A. All crane equipment shall be operated through a complete lift and lowering cycle and through a complete travel of the bridge and trolley to determine that the equipment shall perform smoothly and safely and that pendant cable length is sufficient to permit operation from desired floor levels. All tests shall be carried out with the bridge crane equipment loaded at 125 percent of capacity. The bridge crane provider shall provide the test weight loads. Any defects shall be corrected by the bridge crane provider without any expense to the Owner.

**3.3 USE BY CONTRACTOR.**

A. If crane is used by the Contractor, it shall be repaired, repainted, and otherwise refurbished to like new condition prior to its acceptance. The Contractor assumes all responsibility for operation and maintenance until the crane has been accepted by Owner.

**3.4 CLEANUP.**

A. Upon completion of work, area shall be cleaned and restored to original condition, acceptable to the Owner.

**END OF SECTION 41 22 13**

# DIVISION 43 – LIQUID HANDLING EQUIPMENT

## SECTION 43 10 50 – GENERAL MECHANICAL PROVISIONS

### PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Work under this section is subject to requirements specified under Divisions 1 of these Project Documents. The provisions of this section apply to all other sections under Divisions 22, 23, 33, and 43.

### 1.2 CODE REQUIREMENTS

A. All work, equipment, and material included under these Specifications shall conform to the requirements of the ordinances and codes having legal jurisdiction. The complete installation shall comply with all applicable National Fire Codes, UL Requirements, and State of Illinois Codes.

### 1.3 PERMITS AND FEES

A. All permits, governmental fees, and licenses shall be secured and paid for as specified in Divisions 1. All other deposits, fees and inspection costs pertaining to installations and work shall be included under the respective section for Divisions 22, 23, 33, and 43. Due and proper notice shall be given to the ENGINEER and all authorities concerned for required inspections.

### 1.4 COMPARISON OF DRAWINGS WITH CONDITIONS

A. The Drawings accompanying these Special Provisions are design drawings and generally are diagrammatic. They do not show the exact location of the equipment. Some field adjustment may be required to fit equipment, piping, pumps, etc., to actual conditions encountered in the field.

### 1.5 MATERIALS, EQUIPMENT AND WORKMANSHIP

A. All equipment and materials shall be of the best quality and shall bear the manufacturer's name, trade name and UL label in every case where a standard has been established for the particular material. All materials and equipment shall be installed in a neat, accurate, and workmanlike manner and in conformance with the manufacturers' recommendations. All systems and equipment shall operate within acceptable noise and vibration limits. All equipment shall be inherently safe and all moving parts shall be covered with guards. UL approved and labeled equipment and materials shall be used where applicable. Materials shall have a maximum flame spread of 25 and smoke development of 50.

B. Performance Specifications take precedence over model numbers.

## 1.6 EQUIPMENT AND MATERIAL APPROVAL DRAWINGS AND SUBMITTALS

A. Drawings and material descriptions shall be submitted to the ENGINEER in accordance with requirements of Division 1 of these Special Provisions as soon as practical after notice to proceed with the work. Submittal shall include the following information:

1. Manufacturer's data sheets on all cataloged items to be used, including cuts, detailed descriptions and necessary shop drawings.

B. Orders for materials and equipment shall not be placed until approval is obtained from the ENGINEER in writing. No shop drawings or submittal sheets shall be used in the work which does not bear the review stamp of the ENGINEER.

C. Submittals shall meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

## 1.7 CUTTING AND PATCHING

A. All necessary cutting, fitting, repairing, and finishing of new masonry work, metal work, carpentry work, sheet metal work, etc. that may be required for the operations contemplated in this Specification shall be provided by each trade for his respective work. This work shall be done by craftsmen skilled in their respective trades.

B. No holes or cuts shall be made in structural steel members or in concrete construction without specific approval of the ENGINEER for each instance.

## 1.8 PROTECTION

A. Each trade shall keep its respective duct openings closed by means of plugs or caps to prevent the entrance of foreign matter. All equipment shall be protected as required against dirt, water, freezing, chemical or mechanical damage, both before and after installation. Equipment damaged prior to final acceptance of the work shall be restored to their original condition or replaced by the respective trade.

## 1.9 GUARANTEE

A. All material and workmanship shall be guaranteed for a period of one year from date of final acceptance of the work. Guarantee shall include all labor, material, and equipment as required to replace or repair any defects in an approved manner.

## 1.10 STANDARDS

A. Wherever a material, article or piece of equipment is identified on the drawings or in the Specifications by reference to manufacturers' or vendors' names, trade names, catalog numbers, or the like, it is so identified for the purpose of establishing a standard, and any material, article, or piece of equipment of other manufacturers or vendors which will perform adequately the duties imposed by the general design will be considered equally acceptable provided the material, article, or piece of equipment so proposed is, in the opinion of the ENGINEER, of equal substance, appearance and function. It shall not be purchased or installed by the CONTRACTOR without the ENGINEER'S written approval.

B. Wherever the following abbreviations are used in these Specifications, or on the Drawings, they are to be construed the same as the respective expressions represented:

| | |
|---|---|
| MHSWPS | Manual for Highway Storm Water Pumping Station |
| AASHTO | American Association of State Highways and Transportation Officials |
| ANSI | American National Standards Institute |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| AWG | American Wire Gauge |
| AWWA | American Water Works Association |
| IPCEA | Insulated Power Cable Engineers Association |
| IES | Illuminating Engineering Society |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |

| | |
|---|---|
| NESC | National Electrical Safety Code |
| UL | Underwriters' Laboratories |
| HIS | Hydraulic Institute Standard |
| FM | Factory Mutual |
| ASHRAE | American Society of Heating, Refrigerating and Air Conditioning Engineers |
| SMACNA | Sheet Metal and Air Conditioning Contractors' National Association |

## 1.11 PROTECTION OF STRUCTURES AND EQUIPMENT

A. Where permanent equipment called for under this Contract is installed before the erection of adequate protective structures, the CONTRACTOR, without additional compensation, shall provide approved effective and durable covers for the purpose of protecting such equipment against damage from the elements for any other cause.

B. All mechanical and electrical equipment shall be coated, wrapped, and otherwise protected from snow, rain drippings or any sort, dust, dirt, mud and condensed water vapor during shipment, storage, installation and at all other times prior to use in service. Full details of proposed protective measures shall be submitted for approval to the Owner.

C. Shipment to the job site of any mechanical and electrical equipment except as noted shall not be made until all roof structures and all other structural concrete work, including stripping of forms, has been completed.

D. Storage of any equipment out of doors at any time other than in transit is absolutely prohibited regardless of the protection furnished. Should storage of equipment become necessary, storage shall be in a weatherproof warehouse. Any cost for equipment protection, warehousing or other work to meet the scheduled completion date shall be deemed to be included under the Contract with no additional payment.

E. All structures, machinery, equipment, piping, electrical conduit, wiring and accessories and appurtenances shall be adequately supported and safeguarded against all damage or injury in performance of work under this Contract. The CONTRACTOR will be held responsible for any such damage or injury resulting from his operations and shall repair such damage immediately and to the satisfaction of the Superintendent.

## 1.12 MEASUREMENT AND VERIFICATION

A. The CONTRACTOR shall examine the Plans and Specifications of each trade and familiarize himself with all job requirements.

B. The CONTRACTOR shall field determine all measurements and construction requirements. Failure to be so informed about the requirements of all Contracts shall not be cause for extra compensation.

## 1.13 APPROVALS AND SUBSTITUTIONS OF MATERIALS OR SYSTEMS

A. Materials, systems, and equipment shall be as indicated. Equipment, materials, or systems listed as approved substitutes may be used, but they must be equal in all respects as to performance, capacity, size, accessories, construction, etc. Any change in piping, wiring, mounting, ENGINEERING, drawings, etc., necessary because of a substitution shall be done by the CONTRACTOR making substitution at no extra cost to the Owner, or other CONTRACTORS.

B. All systems, equipment, and materials shall be of the type and quality herein specified. Should equipment of lesser cost than that herein specified be proposed by the CONTRACTOR and be acceptable to both the Owner and ENGINEER, a corresponding credit shall be granted by the CONTRACTOR to the Owner.

## 1.14 SHOP DRAWINGS

A. The CONTRACTOR shall submit to the ENGINEER for approval, a complete list of manufacturers of equipment proposed for the work. After receiving approval on the equipment manufacturers, this CONTRACTOR shall submit without delay or five (5) copies each of drawings or cuts of all equipment and accessories for the approval of the ENGINEER.

B. Such submittals must contain outline dimensions, operating clearances and sufficient ENGINEERING data to indicate substantial compliance with the Project Documents, and to describe departures, if any.

C. The Contract Plans contain information to a degree of detail which is considered to be both consistent with their scales and adequate to accomplish their purpose. Beyond this point they are diagrammatic. Where the equipment furnished differs materially from that indicated on the Contract Drawings, where indicated, or where the CONTRACTOR considers additional detail of shop drawings essential to the proper fabrication or installation of equipment, he shall prepare such drawings from field measurements and submit for approval. Approval granted on shop drawings is rendered as a service only and shall not be considered as a guarantee of measurements of building conditions; nor shall it be construed as relieving the CONTRACTOR of basic responsibilities under the Contract. Refer to other Specifications for additional shop drawing requirements.

D. The General CONTRACTOR and each Specialty CONTRACTOR involved shall approve shop drawings before submittal. No shop drawings will be reviewed by the ENGINEER unless the CONTRACTORS state that the equipment will meet space requirements and contract requirements.

E. All drawings shall be 8½ x 11 or the size of the ENGINEERING drawings.

## 1.15 SPECIFICATIONS AND PLANS

A. The Plans and Specifications are to be taken together. Work specified and not shown or work shown and not specified shall be performed or furnished as though mentioned in both Specifications and Drawings. If there is a discrepancy between the Drawings and Specifications as to the quantity or quality to be provided, the greater quantity or better quality shall be provided.

## 1.16 TESTING

A. All mechanical equipment and systems shall be adjusted and tested. The CONTRACTOR shall adjust, repair or replace faulty or improper mechanical work or equipment discovered during testing.

B. Tests may be made progressively as portions of the work are complete.

C. Tests shall be made in the presence of the ENGINEER.

D. A written record of tests shall be maintained by the CONTRACTOR and, when complete, it shall be submitted for the record.

E. The CONTRACTOR shall perform all tests necessary to assure proper functioning of materials and equipment. Specific special required tests shall be as described in individual equipment specifications, however, the absence of a specific test requirement does not relieve the CONTRACTOR from responsibility to adequately test the equipment and systems for proper operation.

F. Except where otherwise specifically indicated, testing must be complete prior to final inspection. All instruments, tools, etc., required for the tests shall be provided by the CONTRACTOR. Additional testing may be requested by the ENGINEER during final inspection to spot-check test results or to demonstrate proper functioning of the systems. These tests shall be performed by the CONTRACTOR at no additional cost.

## 1.17 RECORD DRAWINGS

A. Alterations and additions to the mechanical installation depicted on the contract drawings made during the execution of the work shall be neatly and plainly marked in red on a set of

Record Drawings kept at the CONTRACTOR'S field office for the project. These drawings shall be updated as the work progresses and shall be available for inspection during the course of the work.

B. Record Drawings shall be prepared and submitted in accordance with Division 1 of Special Provisions.

## 1.18 DATA TO BE FILED WITH THE OWNER

A. Certain data, as specified herein, shall be furnished to the Owner when installation and testing are complete, before final acceptance.

B. The data shall be compiled in 8-1/2 x 11-inch format in high-quality heavy-weight, hard cover binders with piano-style metal hinges or in an alternate approved format. Large drawings and other materials which would be opened or removed for reading shall be provided with heavy clear plastic pouches within the binders. The number of binders shall be as required to hold all required material without over-filling. Various sections, as appropriate shall have suitable dividers. All volumes shall be labeled.

C. Four sets of the data files shall be provided.

D. As a minimum, the data files shall include a table of contents, final approved shop drawings and product data for all equipment and materials, the manufacturer's maintenance manuals for all equipment furnished under this Division for which maintenance is recommended by the manufacturer. All data shall be neat and clearly legible. The table of contents and tabulations of set points and other recorded test data shall be typed. Sloppy, illegible, inaccurate, or incomplete data will not be accepted.

## 1.19 MAINTANENCE

A. During the course of the construction work and until final acceptance, the CONTRACTOR shall be responsible for maintenance and operational integrity of the facility as specified in Division 1.

## 1.20 FINAL ACCEPTANCE

A. When the work is complete, tested and fully operational, and only after the Record Drawings have been reviewed and accepted, the CONTRACTOR shall schedule a Final Acceptance Inspection with the ENGINEER.

B. The Final Acceptance Inspection shall be made for the complete work at the facility as a whole and shall

**END OF SECTION 43 10 50**

# DIVISION 43 – LIQUID HANDLING EQUIPMENT

## SECTION 43 20 10 – VALVES AND APPURTENANCES

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. This section includes the furnishing and installation of all valves and miscellaneous piping appurtenances as shown on the Drawings and as specified herein.

B. All valves shall be furnished and installed complete and operable at the locations and configurations indicated on the Drawings.

C. Performance tests on all valves shall be performed in accordance with the guidelines set forth in this section.

### 1.2 RELATED WORK

A. Work under this Section is also subject to the requirements specified under Division 1 of these Special Provisions.

B. Section 09 91 00: Painting

C. Section 33 40 10: Interior Pipe and Appurtenances

D. Section 33 40 20: Pipe Hangers and Supports

E. Section 33 40 30: Pipe Specialties

F. Section 43 01 50: General Mechanical Provisions

G. Division 26: Electrical

## 1.3 QUALITY CONTROL

A. All valves, operators, and appurtenances shall be furnished by an established and reputable manufacturer with 5 years of experience in manufacturing of valves for water/wastewater.

B. All equipment shall be new, of first class materials and construction, and guaranteed to perform the service required. Equipment shall conform to the Special Provisions, and shall be the product of the listed manufacturer, or similar and equal thereto, as approved by the ENGINEER

C. All valves of the same type shall be from the same manufacturer. Parts of valves of the same type and size shall be interchangeable.

## 1.4 SUBMITTALS

A. The CONTRACTOR shall prepare and submit, for approval, drawings and details of the valves, operators and miscellaneous piping appurtenances that demonstrate the equipment being submitted complies with this Specification, including the following items:

1. Installation instructions, manufacturer's product data, assembly views, lubrication instructions, and replacement parts list.

2. Certified drawings indicating materials of construction.

3. Painting Procedures.

4. Operation and Maintenance manuals.

B. Warranties shall be provided from the manufacturer for a period of five (5) years after the date of final acceptance and shall extend to the OWNER.

C. In addition to the requirements of Paragraph A above, valve actuators shall require the following additional submittal information:

1. Actuator and motor shop test results.

2. Schematic control and power wiring diagrams.

3. Torque settings.

4. Certification for the manufacturer that the actuator is suitable for the service conditions specified and indicated.

D. In addition to the requirements of this section, submittals shall also meet the requirements

of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

### 1.5 BASIS OF PAYMENT

A. The work under shall be paid as part of the Contract lump sum price for PUMP STATION MECHANICAL WORK which shall be payment in full for the work described herein.

## PART 2 – PRODUCTS

### 2.1 GENERAL

A. All valves shall have non-rising stems, unless otherwise shown or specified. All valves shall open when the handwheel, chainwheel, or operating nut is turned counterclockwise. Each operator shall be marked with an arrow and the word "Open". Provide operator types and configurations as indicated on the Project Drawings for knife gate valves.

B. End connection of valves shall be as indicated on the Project Drawings.

### 2.2 FLANGES

A. Flanges shall be cast solid and faced accurately at right angles to the axis of the casting. Flanges shall be faced and drilled and shop coated with a rust preventive compound before shipment.

B. Dimensions and drillings of flanges shall meet the requirements of ANSI B16.1, Class 125, unless otherwise specified or indicated on the Project Drawings. Special drillings shall be provided where required.

C. Flanges shall meet the requirements of Section 33 40 10, Interior Pipe and appurtenances.

### 2.3 KNIFE GATE VALVES

A. Knife gate valves shall be rising-stem, bonnetless, wafer type made with a cast iron body.

B. Flanges shall be drilled and tapped in accordance to ANSI B16.5, Class 150 and MSS SP-81.

C. All wetted parts and the valve stem shall be 304 or 316 stainless steel. Stainless steel liner shall extend through the valve chest to the top of the packing gland.

D. The valve gate shall be suitable for a 0 psi to 150 psi pressure differential.

E. Valve shall have a round port with a replaceable EPDM resilient seat interlocked by a stainless steel retaining ring. The retaining ring shall act as a wiper blade to clean the gate before it passes over the seat. The resilient seat shall be captured and locked into place on three sides only exposing one surface for sealing. The seat shall be raised with a relieved area around the seat to prevent jamming.

F. Valve port shall be full diameter port with no guides or wedges obstructing the port flow area.

G. All ductile iron surfaces (interior & exterior) shall be coated with an epoxy coating per Section 09 91 00**.**

H. Operators shall be handwheel or chainwheel type as indicated on the Project Drawings. Handwheels shall have a diameter of 16" (maximum).

I. Knife gate valves shall be manufactured by Red Valve, Davis Valve, Kolink Valve, ThomasNet.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. General

1. All valves shall be furnished and installed complete with operators, fittings, and piping as required.

2. Valves shall be installed in the positions indicated on the Drawings consistent with operators as indicated. All valves shall be carefully erected and supported in their respective positions free from all distortion and strain on appurtenances during handling and installation. All material shall be carefully inspected for defects in workmanship and material, all debris and foreign material cleaned out of valve openings and seats, all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the CONTRACTOR'S expense.
3. Valves shall be installed and supported adequately in conformance with the instructions of the manufacturer, and as indicated and specified.

4. A gasket of uniform thickness shall be provided between flanges of valves in accordance with Section 33 40 10, Interior Pipe and Appurtenances.

B. Provide the services of factory-trained service technician for valve actuator installations, specifically trained on type of equipment specified. Service technicians shall be required for a minimum ½ person-day per actuator, and be present for the following tasks as recommended by the actuator manufacturer:

1. Functional testing and calibrations.

2. Field performance testing.

3. Field operation and maintenance training.

4. Any additional time required to assist in placing the equipment in operation or to correct deficiencies in installations, equipment or material shall be provided at no additional cost to the OWNER.

## 3.2 TESTING

A. All valves shall be given a hydrostatic shop pressure test at twice the working pressure specified. The valves shall be tested, first by applying the hydrostatic pressure with the valve open, and then with the valve closed. The valves shall be tight and secure under the test pressure.

B. Field testing shall be conducted in conjunction with the testing of the piping system in which the valve is installed.

## 3.3 PAINTING

A. Valve factory coating for interior and exterior surfaces of the valves shall be Liquid Bonded Epoxy and meet the requirements of the AWWA C550 latest revisions entitled “Protective Interior Coatings for Valves and Hydrants”.

B. Field painting of the valves and miscellaneous piping appurtenances shall be in accordance with the requirements specified under Section 09 91 00, Painting.

**END OF SECTION 43 20 10**

# DIVISION 43 – LIQUID HANDLING EQUIPMENT

## SECTION 43 21 39 – SUBMERSIBLE PUMPS

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Work under this Section includes the furnishing and installation of pumping units, base supports and pedestals, base elbows, and any associated items and appurtenances, complete and operational, as specified herein and on the Project Drawings.

B. Each pump shall be designed as a completely submersible wastewater pump capable of pumping storm water, which may consist of sewage containing solids or fibrous material at the design criteria specified herein.

C. The CONTRACTOR shall install and place in operation each pump provided by the pump manufacturer and shall provide all additional supports, fittings, power and control wiring, and accessories not provided by the pump manufacturer for a complete and functional pumping system. The pumps controls, electrical, SCADA, and piping shall be provided as indicated in other sections of the Special Provisions.

### 1.2 RELATED WORK

A. Work under this Section is also subject to the requirements specified under Division 1 of these Special Provisions.

B. Section 09 91 00: Painting

C. Section 33 40 10: Interior Pipe and Appurtenances

D. Section 33 40 20: Pipe Hangers and Supports

E. Section 33 40 30: Pipe Specialties

F. Section 43 10 50: General Mechanical Provisions

G. Section 43 20 10: Valves and Appurtenances

H. Division 26: Electrical

I. Division 40: SCADA

## 1.3 QUALITY CONTROL

A. The pumps furnished under this Section shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished.

B. The manufacturer shall be responsible for the operation and integration of all component parts, whether manufactured by the manufacturer or by third-party vendors. All equipment shall be new and of first class materials and construction, guaranteed to perform the service required.

C. To ensure that all equipment is properly coordinated and will function in accordance with the intent of these Specifications, the CONTRACTOR shall obtain all the equipment specified herein from a pump manufacturer that shall be vested in the responsibility for the proper function of the pumps, including motors and accessories as shown on the Project Drawings and as specified. The CONTRACTOR, however, shall retain overall responsibility for equipment and control coordination, installation, testing, and operation.

D. If the power demand of pumping units proposed to be provided for this Project exceeds the maximum horse power as specified, it is the CONTRACTOR'S sole responsibility without additional cost to the OWNER to upgrade all affected electrical facilities such as, but not limited to, wiring, conduits, motor controls, switchgear, transformers and incoming facilities to be able to operate all the pumping units satisfactorily and to meet the Specifications.

## 1.4 SUBMITTALS

A. Submit the following documents:

1. Shop Drawings showing all important details and loads on supporting structures including, but not limited to, the following:

   a. All dimensions, calculations, and other information to be in USA English units of measure.

   b. Complete description of all equipment being supplied including capacity, size, and materials of construction.

   c. Certified shop and installation drawings showing plan, elevation, and appropriate cross sections and views, all details of construction, dimensions, piping connections, supports and spacing, and anchor bolt locations.

   d. A complete schedule of materials and components.

e. The weight of each component.

2. Descriptive literature, bulletins, and/or catalogs of the equipment including major subcomponents.

3. Pump/motor performance data including expected performance curves at operating conditions indicating speed, output capacity, total dynamic head, brake horsepower, and efficiency for each design point shown as in this Section.

4. Description of surface preparation and shop prime and finish painting of the equipment.

5. Complete motor data including a performance chart showing curves for torque, current, power factor, input KW, full load amperage, locked motor amperage, maximum one-half cycle inrush starting current, operating point amperage and efficiency. This data shall also include information on starting and no-load characteristics.

6. Data sheets and product manuals for all instrumentation.

7. A list of the manufacturer's recommended spare parts for five (5) years of operation, if any.

8. Manufacturer’s certification that all materials to be furnished are in compliance with the applicable requirements of this specification and Division 1 Specifications.

9. Installation instructions, including storage, handling, installation, and inspection of all equipment furnished under this specification with certification that the equipment is suitable for the installation shown on the drawings and the operating purpose intended.

10. Complete description of the warranty to be provided.

11. Proof that each pump/motor has been certified by UL or equivalently recognized independent testing laboratory for the model and size proposed.

12. Manufacturer’s certification that the pump pedestals and supports to be constructed by the CONTRACTOR are suitable for the installation and operation of the pumps to be supplied.

B. Operating and Maintenance Manuals:

1. All dimensions, calculations, and other information to be in USA English units of measure.

2. Provide a list of components and catalog cuts fully describing all items including, but not limited to, all mechanical, electrical, and structural components:

3. General description of pump with certified performance data, pump curves, and model number.

4. Provide detailed information on structural, mechanical, electrical, or other changes or modifications necessary to adapt non-specified materials to the arrangement or details shown on the Drawings.

5. Mechanical drawings with general arrangement showing equipment dimensions, overall weights, weights of largest components requiring removal for maintenance, and clearances required around unit for maintenance access if applicable.

6. Indicate surface preparation and paint specifications.

7. Description of power and process control logic and process and instrumentation diagrams.

8. All scheduled maintenance requirements and routine inspections. Include maintenance summary forms.

9. A list of recommended spare parts.

10. A troubleshooting guide.

11. A detailed description of available service agreement programs.

12. The local sales representative contact information with the company name, contact person, phone numbers, email address, and physical address.

B. All items required for submittal shall be submitted as a single package.

C. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

## 1.5 QUALITY ASSURANCE

### A. General

1. Pumping equipment shall be produced by a manufacturer who regularly engages in the design, manufacture, assembly and production of submersible sewage

pumping equipment of the size and type as specified for not less than five years.

2. Motor wiring shall be rated for service in hazardous Class 1, Division 2, and Group D location.

3. All materials used in the construction of the equipment herein specified shall be new and of the highest available grade and of properties best suited the Work required.

4. One manufacturer shall be responsible for providing pumping equipment, including pump motor and all accessories.

5. Unless otherwise indicated, all pumps of a specified type under this Section shall be identical, the product of the same manufacturer.

6. To ensure that all equipment is properly coordinated and will function in accordance with the intent of these Specifications, the CONTRACTOR shall obtain all the equipment specified herein from the pump manufacturer in whom shall be vested unit responsibility for the proper function of the complete system, including pumps, motors, electrical, control equipment and accessories as shown and specified. CONTRACTOR, however, shall retain overall responsibility for equipment coordination, installation, testing, commissioning and operation.

**B. CONTRACTOR'S Responsibility**

1. If the power demand of pumping units proposed to be provided for this Project exceeds the maximum horse power and/or full load amps as specified and as provided or shown in the Drawings, it is the CONTRACTOR'S sole responsibility, without additional cost to the Department, to upgrade all affected electrical facilities such as, but not limited to, wiring, conduits, motor controls, switchgear, transformers and incoming facilities to be able to operate all the pumping units satisfactorily and to meet the Specifications.

**C. Manufacturer's Certifications**

1. Submit manufacturer's certification that he has carefully examined all of the Contract Documents in detail, including the arrangement and conditions of proposed structure affecting the performance of the pumping equipment units, and the detailed requirements of manufacturing and subsequent installation of the pumping equipment units.

2. Submit manufacturer's certification that there are no omissions, ambiguities, or conflicts in the Contract Documents or in the pumping station piping layout that affect the pumping units, as shown on the Drawings which have not already been clarified in

writing by the ENGINEER.

3. Submit manufacturer's certification that they have reviewed the location and discharge piping design, the discharge valve locations and types, the loads imposed on the pumping units for the connections, the pumping unit locations such as the physical separation to each other and adjacent walls, the water to be pumped and pumping station piping layout, as shown on the Drawings, and that any incidental modifications thereto will not affect the specified pumping unit performance and efficiency to be furnished under this Contract, and they will be solely responsible for furnishing and delivering pumping equipment that will perform and meet the requirements, as specified in the Contract Documents.

4. Submit manufacturer's certification that they have inspected the storage of the pumping equipment and find no conditions that have adversely affected the equipment.

5. Submit manufacturer's certification that they have supervised the installation of the pumping equipment and that the pumping equipment has been properly installed.

6. Submit manufacturers' certification that they have inspected the pumping equipment after 1000 hours of operation and certify the pumping equipment is operating satisfactorily.

7. Submit manufacturer's certification that the pumps were certified by UL and/or FM as listed in these specifications and meet the requirements of Class 1, Group D, Division 2 hazardous location. Pumps shall be of explosion proof design.

**D. Data to be filed with the ENGINEER**

1. Record Drawings: The CONTRACTOR shall keep one record copy of all Specifications, Plans, Addenda, Supplementary Drawings, Working Drawings, Change Orders and Clarifications at the site in good order. Specifications, Plans, Supplementary Drawings and Working Drawings shall be annotated to show all changes made during the construction process. These shall be available to the ENGINEER at all times and shall be delivered to the ENGINEER upon completion of the work.

2. Four bound copies of operating and maintenance instructions, diagrams, parts, lists, requirements and other information pertinent to the operation of the various systems and equipment including bill of material with technical description, detailed technical data sheets, record shop drawings, catalog cut highlighting applicable data shall be furnished to the ENGINEER. Refer to Division 1 Specifications.

**E. Source Quality Control**

1. Factory tests shall be performed on each pumping unit including spare pump in accordance with the test code of the current Hydraulic Institute, except as modified herein. The pumps shall be tested in the position that they will be installed. Pumps main duty point shall demonstrate compliance with Grade 1U from Hydraulic Institute Standard 11.6.

2. Detailed factory test procedures shall be submitted prior to testing.

3. Tests shall be conducted at rated speed to determine the curves of bead, electric input kilowatts, and overall efficiency, Wire to water, as a function of capacity. A minimum of six points shall be taken, including shutoff. One point shall be as near as possible to each specified condition of head and capacity and the remaining points at capacities necessary to provide a uniform distribution of data. Capacity shall be expressed in gallons per minute and head shall be expressed in feet. Raw test data, calculated results and sufficient information tor computation and plotting of the curves shall be furnished with the certified shop test curves.

4. Certified test curves shall be finished for approval prior to shipment. All tests shall be witnessed by the manufacturer by a Registered Professional ENGINEER registered in the state in which the shop tests are performed. The witnessing Registered Professional ENGINEER shall sign and seal each copy of the curve and test data sheets. Six copies of the curves along with the certified drive unit test data, shall be furnished for approval. Shipment of the pumping units shall not be made until the test data and curves arc approved.

5. Curves shall be drawn to such scale that values can be read accurately within 1%. The efficiency curves submitted shall constitute a guarantee within 1% on the scale for all deliveries between 3/4 rated capacity and 1-1/4 rated capacity.

6. In addition to the hydraulic test, the pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:

    a. Impeller, motor rating and electrical connections shall first be checked for compliance with the Specifications.

    b. Motor and power cable insulation shall be tested for moisture content or insulation defects with a mega-ohm meter.

    c. Winding resistance factory test for pump motors.

    d. Moisture and temperature detector factory tests and describe acceptance and rejection criteria.

e. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

f. Describe tests acceptance and rejection criteria.

g. The pump shall be run for 30 minutes submerged a minimum of 6 ft. under water.

h. After operational test and hydraulic test the moisture and temperature detector tests as described in 1.5.E.3 and the insulation test 1.5.E.6 shall be performed again and readings shall be recorded. A written report, stating the foregoing steps have been done, shall be submitted prior to shipment.

i. Each pump shall be subjected to a hydrostatic test and certification of the hydrostatic test shall be provided. The hydrostatic pressure shall, in any case, not be less than 150% the shut-off press of the pump as shown by the characteristic curve. The minimum test duration time shall be 10 minutes.

j. TI1e certified test reports shall be submitted within two weeks from the completion of the tests. The results shall be certified that the equipment supplied meets the contract requirements.

7. The CONTRACTOR shall provide transportation and reasonable expenses to and from all factory pump testing for two (2) representatives of the Department to witness such testing. The Department shall designate these individuals. The CONTRACTOR shall notify the ENGINEER of a scheduled test date two months prior to said date and shall arrange an exact suitable date not less than two weeks prior to the test.

## 1.6 WARRANTY

A. Refer to Division 1 Specifications.

B. The submersible pumps, including all subcomponents and appurtenances furnished by the manufacturer shall be warranted for a period of three (5) years, on a non-prorated basis, from the date of final acceptance under the operating conditions specified and warranted to be free from defects in workmanship, design or material. If the pumps should fail during the warranty period due to a defective part(s), the defective part(s) shall be replaced and the equipment restored to service at no expense to the OWNER.

C. This warranty shall not deprive the OWNER of other rights the OWNER may have under other provisions of the Contract Documents and is in addition to and runs concurrent with the warranties made under the requirements of Contract Documents.

D. Parts availability shall be guaranteed from the manufacturer for twenty (20) years from the date of initial operation. Should replacement parts not be available, the manufacturer must bring the unit to full working condition or replace the failed component with a new unit providing equal performance at no cost to the OWNER.

## 1.7 PUMP OPERATION

A. Pump operation is described in Division 40 Specifications.

B. CONTRACTOR shall be responsible to provide fully integrated facilities, which perform as described in this section, on the Drawings, and in other specification sections.

## 1.8 BASIS OF PAYMENT

A. The pumping equipment shall be paid for per contract unit price each for

MAIN PUMPS
LOW FLOW PUMP

which shall be payment in full for the work described herein unless otherwise noted.

# PART 2 - PRODUCTS

## 2.1 GENERAL

A. The pumps shall be suitable for installation and operation as indicated on the Project Drawings and as required by the Special Provisions.

B. The pump units shall be non-clogging, submersible, centrifugal sewage pumps installed vertically in a dry well area as indicated on the Project Drawings. The pumping units shall be designed for continuous and intermittent duty.

C. All components must be listed and labeled by Underwriter's Laboratory (UL) or equivalently recognized independent testing laboratory for operation in a NEC Class 1, Group D, Division II hazardous location. Pumps shall be of explosion proof design.

D. The equipment shall be suitable for continuous operation in a high humidity environment and at full nameplate load while the motor is completely submerged, partially submerged, or totally non-submerged.

E. All components shall be current production models.

F. Pumps shall be manufactured by Xylem Inc.-Flygt; no substitutions allowed.

G. All pumps of a specified type shall be identical, the product of the same manufacturer. All mainn pumps within the pump station shall be interchangeable at any location without requiring piping and flange modification, and all main pumps shall identical with respect to their technical rating, dimensions and flange connections.

## 2.2 PUMP CHARACTERISTICS

A. The pumps shall be designed for operation as follows:

1. Pump performance requirements of Main Flow Pump (MFP-1), Main Flow Pump (MFP-

2), and Main Flow Pump (MFP-3):

| Performance Criteria | Requirement |
|---|---|
| Capacity at Primary Design Point (gpm) | 5,700 |
| Total Dynamic Head (TDH) at Primary Design Point (feet) | 28.5 |
| Min. Wire-to-Water Efficiency at Primary Design Point (%) | 65.0 |
| Capacity at Design Point No. 2 (gpm) | 6,400 |
| TDH at Design Point No. 2 (feet) | 24.5 |
| Capacity at Design Point No. 3 (gpm) | 6800 |
| TDH at Design Point No. 3 (feet) | 21 |
| Minimum shut-off TDH (feet) | 71 |
| Maximum Pump Speed (rpm) | 1,185 |
| Nominal Motor horsepower (hp) | 70 |
| Minimum Motor Efficiency at Full Load (%) | 91 |
| Frequency (Hz) | 60 |
| Minimum Motor Power Factor at Full Load | 0.80 |
| Maximum Locked Rotor kVA/hp NEMA code letter | H |
| Pump Suction Diameter (inches) | 16 |
| Pump Discharge Diameter (inches) | 12 |
| Maximum Height of Installed Pumping Unit (inches) | 96 |
| Minimum diameters of the sphere that will pass through Pump (inches) | 4.0 |

Pump performance requirements of Low Flow Pump (LFP-1):

| Performance Criteria | Requirement |
|---|---|
| Capacity at Design Point (gpm) | 1,900 |
| Total Dynamic Head (TDH) at Primary Design Point (feet) | 26.0 |

| | |
|---|---|
| Min. Wire-to-Water Efficiency at Primary Design Point (%) | 66.5 |
| Capacity at Design Point No. 2 (gpm) | 2,000 |
| TDH at Design Point No. 2 (feet) | 25 |
| Capacity at Design Point No. 3 (gpm) | 2,100 |
| TDH at Design Point No. 3 (feet) | 22 |
| Minimum shut-off TDH (feet) | 65 |
| Maximum Pump Speed (rpm) | 1,760 |
| Motor horsepower (hp) | 20 |
| Minimum Motor Efficiency at Full Load (%) | 87 |
| Frequency (Hz) | 60 |
| Minimum Motor Power Factor at Full Load | 0.83 |
| Maximum Locked Rotor kVA/hp NEMA code letter | G |
| Pump Suction Diameter (inches) | 10 |
| Pump Discharge Diameter (inches) | 10 |
| Maximum Height of Installed Pumping Unit (inches) | 60 |
| Minimum diameters of the sphere that will pass through Pump ( inches) | 2.3 |

B. Each pumping unit shall be non-overloading throughout the entire operating range and shall have stable head-capacity characteristics so that the pumps shall be capable of operating at the low end of the pump curve without damage to the pump or motor as the head shall continue to decrease with an increasing capacity. The pump units shall be capable of sustaining full reverse runaway speed without damage.

C. Pump discharge and suction diameters shall be sized in accordance with the dimensions indicated on the Project Drawings.

**2.3 PUMP DESIGN**

A. The pump(s) shall be capable of handling storm water at the design parameters indicated in this Section of the Special Provisions.

B. All pumps shall be furnished with base elbows with 125 pound flat face ANSI flanges, meeting ANSI standard B16.1 and in accordance with Section 33 40 10.

C. Pumps shall be designed for use in a dry well application as indicated on the Project Drawings. Pump shall be of submersible construction with provisions included so that the pump and motor will maintain proper cooling, and will continue to operate satisfactorily should the dry well be subjected to flooding.

D. A heavy-duty steel base shall be provided by the pump manufacturer for mounting on the pump pedestals as indicated on the Project Drawings. The baseplate will span two concrete pedestals as shown in the project drawings. The pedestals shall be supplied by the CONTRACTOR. The base shall be designed to support the weight of the pump and motor.

E. Pumping units shall include suction elbows as indicated on the Project Drawings.

## 2.4 PUMP CONSTRUCTION

A. All major pump components, including casing/volute, motor frame, and discharge elbow, shall be manufactured from cast iron, ASTM A-48 (Class 30 or better).

B. All exposed bolts and nuts and miscellaneous hardware in contact with the pumped material shall be stainless steel.

C. The impeller shall be of Duplex Stainless Steel (ASTM CD-4MCuN) and shall be non-clogging without deforming, cutting, or chopping the solids. The impeller may be of single or multiple vane design, shall be smooth and finished throughout, and free of sharp edges. The impeller shall have a means of preventing the accumulation of solids or stringy material. The impeller shall be capable of being trimmed to meet specific hydraulic requirements and shall be held securely in place such that it is mechanically prevented from loosening by torque from either forward or reverse rotation.

D. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be of ASTM A-48, Class 35B cast iron and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

E. The pump volute shall be of single piece design. Passages shall be smooth and large enough to pass any solids which may enter the impeller. The discharge flange design shall permit attachment to standard ANSI flanges/appurtenances.

F. The rotating assembly (impeller, shaft, and rotor) shall be dynamically balanced such that undue vibration or other unsatisfactory characteristics will not result when the pump is in operation.

## 2.5 SHAFT AND SHAFT SEALS

A. The pump and motor shaft shall be of one piece construction, amply sized to minimize shaft deflection. Each shaft shall be of stainless steel material and adequately designed to meet the maximum torque required at any normal startup condition or operating point in the system. Maximum deflection shall not exceed 0.002" at the lower seal. Each pump shaft shall be accurately machined to accommodate bearings, seals, and impeller. Carbon steel or chrome-plated shafts are not allowed.

B. Each pump shall be equipped with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. Each seal interface shall be held in contact by its own spring system. The seals shall not require routine maintenance or adjustment, and shall not be dependent on the direction of rotation for proper sealing. Seals shall be made of tungsten-carbide or silicon-carbide.

C. Each pump shall be provided with a lubricant chamber for the shaft sealing system, which shall provide superior heat transfer and maximum seal cooling. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug shall be easily accessible from the outside of the pump.

D. When required, seal oil inspection shall be achieved without disassembly of the pump. The seal shall not require the pumped liquid as a lubricant nor shall the lower portion of the seal be mounted in the pumped medium.

## 2.6 BEARINGS

A. Each pump shaft shall rotate on a minimum of two, permanently lubricated, greased, upper and lower bearings. Bearings shall be of sufficient design and spacing to properly transfer all radial and axial loads to the pump housing and minimize shaft deflection. Bearings shall be sized to provide a minimum L-10 bearing life of 50,000 hours anywhere on the flow versus head curve and shall protect the pump/motor from thrust in reverse directions.

## 2.7 COOLING SYSTEM

**A.** Each pump shall be provided with an integral motor cooling system, consisting of a liquid chamber or jacket encircling the motor stator housing to provide heat dissipation by the uniform circulation of cooling liquid. The cooling media channels shall be non-clogging and shall not allow solids to enter or accumulate in the cooling media. The cooling system shall not allow air pockets to accumulate within the cooling media. The cooling system shall provide for continuous pump operation in liquid temperature up to 104 degrees F.

## 2.8 PROTECTION SYSTEMS

### A. LEAKAGE DETECTION

1. A leakage sensor shall be used to monitor and detect water in the stator chamber. The leakage sensor shall consist of a minimum of two (2) moisture probes or a single float switch, which when activated shall send an alarm. The alarm shall activate if leakage into the chamber reaches 50% chamber capacity (maximum), signaling the need to schedule an inspection.

### B. TEMPERATURE

1. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. An alarm signaling an overheating of the motor shall activate should the thermal switches open.

## 2.9 MOTOR

A. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The motor shall be rated in accordance with NEMA MG1, Part 31. Motors shall be suitable for operation in a NEC Class 1, Group D, Division II hazardous location.

B. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 30 evenly spaced starts per hour. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to control system. The motor shall be capable of operating pumps over the entire range of pump curves operating conditions without overloading and without using the service factor.

C. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be provided by the same manufacturer.

D. The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C.

E. Power to each pump motor shall be 460 Volt, 3 Phase, 60 Hz.

## 2.10 POWER AND CONTROL CABLES

A. Power and control cables conforming to the requirements of Division 26 of these specifications of length sufficient to allow connection to a control panel and/or junction box without splicing shall be factory installed and sealed watertight. Cable supports, grips, and other appurtenances shall be stainless steel.

B. Power and control cables shall be neatly coiled and held in place with wire-ties or similar to preclude damage to the seals during shipment.

C. The cable entry seal design shall insure a watertight and submersible seal to prevent liquid from entering the motor housing. The cable entry assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top.

## 2.11 OPERATION AND CONTROL

### A. General:

1. CONTRACTOR shall be responsible for providing fully integrated facilities, which perform as described in this section, the plans, and in other specification sections.

2. The pump controls shall be provided in accordance with Division 26, Electrical and Division 40, SCADA.

3. Pumps shall function in rising water and in falling water as shown on the Project Drawings. Float level detecting devices shall be located in the wet well as shown, with one float supplied for each control level.

### B. Pump Monitoring Module

1. Furnish and install one Flygt MiniCAS (Mini Control and Status) module to monitor temperature and leakage detectors installed in each Flygt pump. The MiniCAS shall be capable of monitoring the thermal switches embedded in the stator end coils, the Flygt FLS (float switch type) water-in-stator-housing sensor. The MiniCAS shall monitor both the series connected thermal switches and leakage sensor(s) by outputting 12 VDC on a single two wire circuit. The MiniCAS circuitry shall operate on the current sensing principle whereby a change in temperature or leakage condition shall change the resistance of the associated sensor and thus alter the current in the sensing circuit. The MiniCAS shall contain two sets of form C dry contacts, one for over-temperature and one for leakage. The dry contacts shall change status upon occurrence of an over temperature or leakage condition to other control components in the pump control panel.

In the case of an over-temperature, and in keeping with Flygt's warranty policy, the over-temperature dry contacts shall be used to trip the pump off line. The MiniCAS shall be designed to be plugged into a standard 11-pin circular socket. Detailed technical data and wiring connections shall be found in the MiniCAS Manual.

## 2.12 SUPPORT

A. All equipment bolts, nuts, mounting plates, support brackets, washers, and accessories shall be A316 stainless steel, furnished by the equipment manufacturer.

B. Manufacturer shall furnish a template to accurately locate the bolts for bolting the discharge elbow, mounting plates, support brackets, and accessories to install as indicated on the Project Drawings.

## 2.13 SHOP PAINTING

A. All ferrous surfaces coming into contact with the pumped media shall be cleaned, primed and finish-painted at the factory with a spray coating of modified vinyl-zinc prime followed by a modified acrylic resin finish that meets or exceeds the requirements stated in Section 09 91 00.

## 2.14 SHOP ASSEMBLY AND INSPECTION

A. Each submersible pump/motor shall be completely factory assembled and shipped ready for installation to include the power and control cables.

B. Shop inspection shall be performed by a qualified inspector and certified by the manufacturer. The inspection shall be documented and all deficiencies noted, corrected, re-inspected and final completion formally authorized. Final shipment authorization shall be by the manufacturer to ensure completion of all fabrication, assembly, and inspection requirements. Inspection records and evidence of inspector qualification shall be submitted to the ENGINEER upon request.

## 2.15 FACTORY PERFORMANCE TEST

A. Upon completion of assembly, each pump shall be performance tested at the Manufacturers US facility witnessed by a Licensed Professional ENGINEER experienced in the testing requirements of the most recent test code of the Hydraulic Institute.

B. The submersible pumps shall be tested before shipment. Certified test curves and reports shall be furnished and approved prior to any pump shipment.

C. The Licensed Professional ENGINEER shall sign, stamp and date the test procedure and results, certifying that the pumps were tested in the pump manufacturer's facility.

D. Prior to testing, the manufacturer shall submit a detailed test plan with complete piping and instrumentation configuration diagram showing discharge pipe size. The location and quantity of all major instruments necessary for performance data, with corresponding distances from reference points, shall be identified. As a minimum the test plan shall include:

   1. Hydraulic Institute test procedure and method of calculating results.
   2. Functional testing of entire package, instrumentation, ancillary components and local control panel.

E. All test equipment shall be calibrated and certified by an independent test agency no more than 12 months prior to the test date. Certificates shall show the stability of calibration over a period of at least one year.

F. At a minimum, the submersible pumps shall be factory tested for a duration of not less than thirty (30) minutes at maximum load.

G. A power meter calibrated to NIST standards instantaneously monitoring all electrical legs for voltage and amperage to calculate instantaneous power usage shall measure the electrical power input as described, including all auxiliary systems. Measured power shall include wire-to-water and include all losses associated with electrical power, including, but not limited to the motor.

H. Tests shall be conducted at rated speed to determine the curves of head, electric input kilowatts, and overall efficiency, wire to water, as a function of capacity. A minimum of six points shall be taken, including shutoff. One point shall be as near as possible to each specified condition of head and capacity and the remaining points at capacities necessary to provide a uniform distribution of data. Capacity shall be expressed in gallons per minute and head shall be expressed in feet. Raw test data, calculated results and sufficient information for computation and plotting of the curves shall be furnished with the certified shop test curves.

I. The Licensed Professional ENGINEER shall sign each copy of the test data log sheet certifying that the required tests were performed in strict accordance with these Specifications and the standards of the Hydraulic Institute. Pumps main duty point shall demonstrate compliance with Grade 1U from Hydraulic Institute Standard 11.6 for primary duty point.

J. Four copies of test results, certified calibration records for all equipment used and signed/stamped test log shall be submitted to ENGINEER for approval and acceptance by ENGINEER prior to shipment of each submersible pump.

K. Test results shall be included in the operations and maintenance manual in the form of head versus capacity graph to include curves for brake horsepower and NPSH for operation at full speed.

L. The ENGINEER and OWNER shall be provided with a minimum two (2) week notice of when the factory testing will be performed. The ENGINEER and a representative of the OWNER shall be allowed to witness the factory testing at no additional cost to the OWNER. The CONTRACTOR shall provide all transportation and lodging expenses for the ENGINEER and the representative of the OWNER to witness the factory testing..

M. If the certified factory test results demonstrate non-compliance with stated performance parameters for each duty point shown in this Specification Section, the submersible pumps shall be reworked and retested until it complies with the Specifications.

N. Such reworking and retesting shall be at the pump CONTRACTOR'S expense including the time and expenses for Representatives of the OWNER to witness the retesting.

O. In addition to the hydraulic performance pump test, the pump manufacturer shall perform the following inspections and tests on each pump as part of the factory witness test:

1. Impeller, motor rating, and electrical connections shall first be checked for compliance with the Specifications
2. Motor cables insulation shall be tested for moisture content or insulation defects with mega-ohm meter.
3. Winding resistance factory test for pump motors.
4. Moisture and temperature detector factory tests and describe acceptance and rejection criteria.
5. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
6. The pump shall be run for minimum 30 minutes.
7. Each pump shall be subject to a hydrostatic test and certification of the hydrostatic test shall be provided. The hydrostatic pressure shall, any case, not to be less 150% of the shut off pressure of the pump as shown by the characteristics curve. The minimum test duration time shall be 10 minutes. The pump shall be dry prior to performing the hydrostatic test.
8. After performing the pump operational test and the hydrostatic test as described above, the insulation test described above shall be performed again and readings shall be recorded. A written report, stating the foregoing steps have been done, shall be submitted prior to shipment.
9. The certified test reports and curves shall be submitted within one week from the completion of the tests. The results shall be certified that the equipment supplied meets the contract requirements.

## 2.16 SPARE PARTS

A. A list of recommended spare parts shall be included in the Operating and Maintenance Manual submitted in accordance with paragraph 1.4.B, which are anticipated to be needed during the warranty period specified in paragraph 1.6. The manufacturer shall supply such spare parts for each pump furnished.

B. Provide two (2) additional spare impellers from the manufacturer for Low Flow Pump-4.

## 2.17 PACKAGING AND SHIPPING

H. Each factory assembled submersible pump and shall be enclosed mounted or crated to protect against damage during shipment.

I. The parts and assemblies that are shipped unassembled including, but not limited to, anchor bolts, accessories, mounting plates, support brackets, nuts, washers, shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate field installation.

J. Spare parts, if any, shall be packed in containers bearing labels clearly designating contents and pieces of equipment to which they are applicable.

## 2.18 TOOLS

A. If any pump components are of such construction that special wrenches, spanners, eyebolts, and tools are required to remove units, bolts, and parts, a complete set of such special tools shall be furnished by the Manufacturer for each pumping unit. The tools shall be of high quality and non-sparking construction. Each set shall be furnished in a metal tool case, which shall have a handle and provisions for padlocking.

# PART 3 - EXECUTION

## 3.1 GENERAL

A. All pumping equipment shall fit in the spaces indicated on the drawings without appreciable revisions to the piping.

B. Portions of the Work requiring Shop Drawings, Product Data or Sample submissions shall not begin until the submission has been approved by the ENGINEER. A copy of each approved Shop Drawing, Product Data and Sample shall be kept in good order by the CONTRACTOR at the site and shall be available to the ENGINEER.

## 3.2 DELIVERY, STORAGE AND HANDLING:

A. Inspect and inventory items upon delivery to site.

B. Store and safeguard equipment, material and spare parts in accordance with manufacturer’s recommendations.

C. Deliver spare parts to OWNER after completion of work.

## 3.3 INSTALLATION

A. Furnish, install, finish, and place in service each submersible pump and all appurtenances in accordance with the manufacturer's recommendations and certified shop drawings, and as approved by the ENGINEER.

B. Securely anchor the pump base plates, mounting plates, and brackets to the wet well floor/pedestal.

C. Verify that each pump is easily installed and removed and that the pump discharge flange mates squarely with the pump base flange.

D. Prior to startup of each pump, CONTRACTOR must provide the ENGINEER a copy of the Certificate of Proper Installation from the manufacturer. All installation and equipment deficiencies must be corrected prior to startup and testing.

## 3.4 ANCHORAGE

A. All anchor bolts, nuts and washers shall be installed by the CONTRACTOR in accordance with the shop and installation drawings and instruction supplied by the manufacturer.

## 3.5 TOUCH-UP FIELD PAINTING

A. After installation and approval of testing by the ENGINEER, apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop paint coating.

## 3.6 MANUFACTURER'S SERVICES

A. Provide the services of a factory trained technician specifically trained on the type of pumping system specified to inspect the installation of the equipment, to make any necessary adjustments and test and place the equipment in satisfactory service. Submit qualifications of technician to ENGINEER for approval. The minimum man-day requirements specified are exclusive of travel time and do not relieve CONTRACTOR of his obligation to provide sufficient service to place equipment in satisfactory operation and in accordance with the manufacturer's instructions and warranty requirements. A written report covering the technician's findings and installation certification shall be submitted to the ENGINEER covering all inspections and outlining in detail any deficiencies noted.

B. Minimum Man-Day Requirements:

| | |
|---|---|
| Initial Installation assistance: | 1 man-day |
| Start-up and calibration: | 1/2 man-days |
| Field running test: | 1 man-days |
| Operation and maintenance training: | 1/2 man-days |

## 3.7 FIELD TEST

A. Written test procedures shall be submitted two weeks prior to field testing. The pumps shall be tested in accordance with the Manufacturer's instructions and Hydraulic Institute Standards.

B. After the installation of the units, the control system, and all appurtenances; the pumps and control system shall be subjected to a field running test under actual operating conditions. The field test shall be conducted by the Contractor in the presence of the ENGINEER, IDOT's Electrical Maintenance Section representative and City of Lake Forest, as directed by the manufacturer's factory trained technician. An adequate water supply shall be furnished for these tests by the Contractor and is included in the cost of the respective pumps. In the absence of an internal recirculation pipe system within the proposed pump station, the Contractor shall furnish, install and operate a properly sized external diesel powered portable pump and hose system to pump and recycle the water being discharged from the pump station back into the influent sewer system for reuse with additional testing operations. The field test shall demonstrate the following under all conditions for each pump and the control system:

1. Has not been damaged by transportation or installation.

2. Is properly installed.

3. Has no physical or mechanical defect.

4. Is in proper alignment.

5. Is properly connected.

6. Has correct rotation of the pump and motor shaft.

7. Current to all motor electrical leads is balanced.

8. Electrical and control cables are free of moisture and insulation defect.

9. Electrical and control cables are tight, properly connected, and labeled and tagged at the terminations.

10. Motor amperage is normal.

11. That there is no motor current imbalance, which shall be verified by measuring current and voltage for each phase.

12. That megger testing on all motors is performed per Division 26 and the manufacturer's requirements and acceptance standards.

13. Is free of overheating of any parts.

14. Is free of all objectionable vibration.

15. Is free of excessive noise.

16. Is free of overloading of any parts.

17. Operates in full conformance to the design criteria specified in Section 2.2.

18. At minimum wet well depths there is no leakage between the pump discharge flange and the pump base flange.

19. Each pump shall be run momentarily against a closed discharge valve with the discharge pressure being monitored, to confirm that the Design Shut-off Head (and proper impeller size) have been furnished.

C. Hand, off, auto, lead/lag bump mode of each pump shall be tested from local control station, SCADA panel and MCC to demonstrate that the pumps and control system operate as specified. Any defects in the equipment or failure to meet the requirements of the Specifications shall be promptly corrected.

1. Each Pump operates as expected at specified levels for on/ off operation based on SCADA entered level variable data.

2. Each Pump operates as expected at specified levels for on/off operation based on ball float level switches.

3. Each pump shall be tested to verify rated flow.

4. Verify that each pup does not operate from local control station or from MCC when hand-off-auto switch is in off position.

5. Each pump start and stop operates as expected manually from MCC and from local control station located at the discharge floor elevation 661.4.

6. Each pump is sequenced as expected for rising and falling water levels in the wet well. This shall be a real water test and pump operation may be simulated by not allowing pump to actually run in order to accomplish testing.

7. Every possible pump auto sequence of each pump shall be tested for lead/lag/standby

for rising and falling water levels based on SCADA controls.

8. Every possible pump auto sequence of each pump shall be tested for lead/lag/standby for rising and falling water levels based on hard wire float mode control through float switches.

D. The following shall be checked on start-up:

1. Current draw and voltage on all legs of each pump shall be observed and recorded to see if there is any imbalance.

2. Megohm meter testing shall be performed on the pump motors and readings recorded for each pump

3. Winding resistance test for each phase shall be performed and readings recorded for each pump.

4. Pump controls and terminations shall be checked.

5. At a minimum, each pump shall be run in circulation a minimum of 30 minutes.

6. Moisture and temperature detector tests and results on each pump shall be recorded.

7. Each PLC I/O point shall be verified for proper operation. Analog signals shall be simulated with multimeter at 0, 4, 8, 12, 16 and 20 mA levels. Results of I/O checkout shall be witnessed by the ENGINEER. A sign-off sheet shall be generated for each I/O point.

E. A minimum of forty-eight (48) hours notification is required prior to testing.

F. All pumps shall be tested by creating actual operating conditions to demonstrate that the pumps and control system operate as specified.

G. The CONTRACTOR is responsible for providing all labor, equipment, water, external pumping equipment, hoses and incidentals required to complete the field running test.

H. A performance test log shall be submitted to the ENGINEER on completion of each test which records the pump model and serial number, test date, beginning test time, ending test time, motor horsepower, rotational speed, and all of the documentation specified in Section 3.7.A.

I. For any equipment that does not satisfy the condition specified, corrective measures shall be taken by the Contractor and pump manufacturer at no additional expense to the OWNER and the equipment retested.

J. Additional expenses associated with having to re-run the testing due to failure by the CONTRACTOR to properly perform the initial test shall be incurred by the CONTRACTOR.

## 3.8 OPERATING AND MAINTENANCE TRAINING

A. The field technician will provide representatives of the OWNER with operation and maintenance instruction for all components of the pumps as required by Division 1 of these Special Provisions.

**END OF SECTION 43 21 39**

## DIVISION 43 – LIQUID HANDLING EQUIPMENT

## SECTION 43 21 43 – SUMP PUMP

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Work under this Section includes furnishing and installation of the sump pump, controls, associated discharge piping, and appurtenances, complete and operational, as specified herein and on the Project Drawings.

### 1.2 RELATED WORK

A. Work under this Section is also subject to the requirements specified under Division 1 of these Special Provisions.

B. Section 09 91 10: Painting

C. Section 33 40 10: Interior Piping and Appurtenances

D. Section 33 40 20: Pipe Hangers and Supports

E. Section 33 40 30: Pipe Specialties

F. Section 43 01 50: General Mechanical Provisions

G. Section 43 20 10: Valves and Appurtenances

H. Division 26: Electrical

I. Division 40: SCADA

### 1.3 QUALITY CONTROL

A. All equipment shall be new and of first class materials and construction, guaranteed to perform the service required.

B. Provide standard sump pump equipment manufactured by a company with no less than five (5) years of experience in the manufacture of such equipment. Manufacturer shall have installed a minimum of five (5) installations of comparable sized sumps.

C. Pump and controls shall be suitable for operation in areas classified as Class I, Group D, Division II, hazardous locations.

### 1.4 SUBMITTALS

D. Complete drawings of sump pumps, controls, and miscellaneous piping appurtenances.

E. Pump performance curves and operational data.

F. Pump Warranty. Warranty shall begin after the date of final acceptance.

G. Painting Procedure and data sheets for shop prime coats.

H. Provide Operation and Maintenance manuals.

I. Spare parts list.

G. In addition to the requirements of this section, submittals shall also meet the requirements of Division 1, Section 1.6, Submittals; including certifications that the equipment and materials to be provided will meet the requirements of this project.

## 1.5 SCOPE

A. Furnish all labor, materials, equipment and discharge piping for the sump pumps, as indicated on the Project Drawings.

B. The work includes, but is not limited to the following:

a. One (1) sump pump

b. One (1) control panel with three (3) floats and alarm.

c. Required power and control wires and cables.

d. All ball valves, check valves, fittings, plumbing specialties, required for all sump pump piping for complete installation.

e. All pipe hangers, supports, anchors, sleeves, concrete inserts to support the various piping systems and equipment.

## 1.6 BASIS OF PAYMENT

A. The work under shall be paid as part of the Contract lump sum price for PUMP STATION MECHANICAL WORK which shall be payment in full for the work described herein.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

1. Hydro-Matic
2. Barnes
3. Zoeller
4. Superior
5. Goulds

### 2.2 SUBMERSIBLE SUMP PUMP

A. One (1) submersible non-clog sewerage pump installed in the Dry Pit sump as indicated on the Project Drawings. The sump pump shall be capable of handling raw, unscreened sewage consisting of water, fibrous materials, and two (2) inch diameter spherical solids. The unit shall utilize a single mechanical shaft seal which will operate in an oil atmosphere.

B. Pump Arrangement: Simplex

C. Rating: Performance criteria – 20 GPM @ 30 Feet TDH

D. Casing: Cast iron housing with protective epoxy coating for corrosion resistance and legs that elevate pump to permit flow into impeller.

E. Pump Discharge: Discharge connection to 2” FNTP pipe connection.

F. Impeller: Vortex type made from cast iron.

G. Seals: Mechanical, Buna-N type.

H. Motor: Thermal overload protection. Include a 3-conductor waterproof power cable and a 5 conductor control cable of length required for installation as indicated on Project Drawings, but not less than 30 feet.

I. Pump Discharge Piping: Field cut, Schedule 80 PVC pipe.

J. Power to pump shall be 480 volt, three phase, 60 Hz.

### 2.3 ALARM SYSTEM AND CONTROL PANEL

A. The pump manufacturer shall supply a completely self-contained simplex motor control panel. The control panel shall provide short circuit and overload protection for the pump.

B. The specified equipment shall be contained in the Sump Pump Control Panel (CP-SP) and be located in the Electrical Room. The control panel shall be integrated into the SCADA system as detailed in this Specification and on the Drawings.

C. Provide a NEMA 12 rated wall mounted electrical enclosure The enclosure shall be formed

of 14 gauge minimum, galvanized steel, with all surfaces phosphatized, then finished inside and out with ANSI 61 gray polyester powder finish. The enclosure shall conform to NEMA standards for type NEMA 12 enclosures and be UL Listed.

D. A ground bus/lug shall be provided in each enclosure. It shall be mounted directly on bare metal. All paint shall be completely removed where the ground-bus/lug is attached to the enclosure or sub-panel. A ground-stud/lug shall be welded on the lower, inside corner on all enclosure doors on which electrically powered devices are mounted. Control panel doors shall be connected to the enclosure ground bus with #8 AWG.

E. The following equipment shall be included with the control panel. This represents the minimum equipment required. Additional equipment may be required base on system operating requirements, manufacture design and NEC,

1. A thermal magnetic circuit breaker with operating handle shall be provided to protect the motor from short circuits and to serve as a motor branch circuit disconnect as required by the NEC. The operating handle shall be accessible from the front of the enclosure and have provisions for “lock-out”. The operating mechanism shall not be through the door of the enclosure. Manufacturer shall be responsible for sizing the circuit breaker per NEC for protection of their equipment.
2. A magnetic starter shall be provided for the pump motor. The starter shall be equipped with a bimetallic overload relay.
3. A control transformer shall be provided to supply 115 volts for the control circuit. The transformer shall be a continuous duty, machine tool type, sized to meet the load requirements of the control circuit. The transformer primary shall be connected to the load side of the circuit breaker. One side of the secondary winding shall be grounded to the component mounting panel. A two (2) pole, 600 VAC, 30 ampere rated fuse block shall be provided for transformer primary winding; a one (1) pole, 250 VAC, 30 ampere fuse block will be provided for the secondary winding. Fuses shall be sized to protect the transformer in accordance with requirements of the NEC.
4. Hand-Off-Auto Selector Switch.
5. Pump “Running” Red Push-to-test type Pilot Light.
6. Pump “Fault” Amber Push-to-test type Pilot Light.

a. “High Water” red colored alarm beacon. The alarm will be initiated when the water level in the sump pit reaches the “High Water” float switch activation level. The “High Water” level shall be no higher than elevation 640.50.

7. Sump pump moisture sensing relay
8. Control power “ON/OFF” selector switch to control power to the floats and circuitry for additional protection.
9. Intrinsically safe relays to interface with sump pump control items located in the Class 1, Group D,Division II environment.
10. Terminal blocks shall be provided for connection of level controls and other control wiring as required for proper pump installation. Provide a minimum of 10% spare terminal blocks.
11. The control shall be wired in accordance with all applicable requirements of the

NEC. Control wiring shall be sixteen (16) AWG minimum red for control circuits and white for neutral grounded conductors. Power wiring shall be a minimum of 12 AWG black. All grounded conductors shall be green. Each conductor shall be numbered. All wiring shall be performed in a net and orderly manner

12. Any other ancillary equipment required to insure proper system operation

F. The following equipment shall be mounted on the control panel enclosure door:

1. Hand-Off-Auto Selector Switch
2. Pump “Running” Pilot Light.
3. Pump “Fault” Pilot Light.
4. Control power “ON/OFF” selector switch.
5. Start and Stop push buttons.

G. The following Inputs and Outputs shall be wired to control panel terminal block for interfacing with the SCADA System.

1. Pump “Running” output from magnetic contactor auxiliary contact.
2. Pump “Fault” output from either the motor overload relay or moisture detection relay.
3. “High Water Alarm” from high water alarm float switch relay.

H. Sequence of Operation

1. Manual Operation

a. When the Hand-Off-Selector switch is in the “Hand” position, the sump pump will start. The sump pump will continue to run until the selector switch is returned to the “Off” position or when the water level in the sum pit is below the “Stop” level sensor float switch activation level.

2. Automatic Control

b. When the Hand-Off-Selector switch is in the “Auto” position, the sump pump will start when the water level in the sump pit is above the “Start” float switch activation level. The sump pump will continue to run until the selector switch is returned to the “Off” position or when the water level in the sum pit is below the “Stop” level sensor float switch activation level.

I. Provide a “Stop”, “Start” and “High Water” level sensor floats, all adjustable, with mounting rods and electric cables. CONTRACTOR shall be responsible for sizing the required cables between the control panel and sump pump pit.

## 2.4 SUMP PUMP DISCHARGE PIPING

A. Sump pump discharge pipe and fittings shall be 2” Schedule 80 PVC. See Section 33 40 10, Interior Piping and Appurtenances for details.

B. Sump pump check valves shall be Schedule 80 PVC ball check. Shutoff valve for sump pump shall be Schedule 80 PVC Thru-Union ball valve, or equal.

## PART 3 – EXECUTION

### 3.1 INSTALLATION - GENERAL

A. General: Connect piping to pumps as indicated on the Project Drawings. Install valves that are same size as piping connecting to pumps.

B. Connect discharge pipe to discharge into the nearest catch basin sewer as shown on the Plans.

C. Install ball check valve and ball valve on sump pump discharge.

D. Install electrical connections for power, controls, and devices.

E. Electrical power and control wiring and connections are specified in Division 26 Sections.

### 3.2 SUMP PUMP ADJUSTING

A. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.

### 3.3 SUMP PUMP COMMISSIONING

A. Final Checks Before Startup: Perform the manufacturers recommended preventive maintenance operations and checks before startup, including the following.

1. Check that pumps are free to rotate by hand. Do not operate pump, if bound or even drags slightly, until cause of trouble is determined and corrected.

2. Check that pump controls are correct for required application.

B. Starting procedure for pumps with shutoff power not exceeding safe motor power:

1. Start motors.

2. Open discharge valves.

3. Observe leakage from stuffing boxes and adjust sealing liquid valves for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.

4. Check general mechanical operation of pumps and motors.

### 3.4 FIELD QUALITY CONTROL

A. Manufacturer's Installation and Start-up Services: None required.

## 3.5 CLEANING AND SHOP PAINTING

A. Paint pumps with manufacturer standard primer in shop and finished coats in field per Section 09 91 00, Painting.

**END OF SECTION 43 21 43**

**PIPE UNDERDRAINS FOR STRUCTURES**
Effective: May 17, 2000 Revised: January 22, 2010

Description. This work shall consist of furnishing and installing a pipe underdrain system as shown on the plans, as specified herein, and as directed by the Engineer.

Materials. Materials shall meet the requirements as set forth below:

The perforated pipe underdrain shall be according to Article 601.02 of the Standard Specifications. Outlet pipes or pipes connecting to a separate storm sewer system shall not be perforated.

The drainage aggregate shall be a combination of one or more of the following gradations, FA1, FA2, CA5, CA7, CA8, CA11, or CA13 thru 16, according to Sections 1003 and 1004 of the Standard Specifications.

The fabric surrounding the drainage aggregate shall be Geotechnical Fabric for French Drains according to Article 1080.05 of the Standard Specifications.

Construction Requirements. All work shall be according to the applicable requirements of Section 601 of the Standard Specifications except as modified below.

The pipe underdrains shall consist of a perforated pipe drain situated at the bottom of an area of drainage aggregate wrapped completely in geotechnical fabric and shall be installed to the lines and gradients as shown on the plans.

Method of Measurement. Pipe Underdrains for Structures shall be measured for payment in feet (meters), in place. Measurement shall be along the centerline of the pipe underdrains. All connectors, outlet pipes, elbows, and all other miscellaneous items shall be included in the measurement. Concrete headwalls shall be included in the cost of Pipe Underdrains for Structures, but shall not be included in the measurement for payment.

Basis of Payment. This work will be paid for at the contract unit price per foot (meter) for PIPE UNDERDRAINS FOR STRUCTURES of the diameter specified. Furnishing and installation of the drainage aggregate, geotechnical fabric, forming holes in structural elements and any excavation required, will not be paid for separately, but shall be included in the cost of the pipe underdrains for structures.

**BITUMINOUS MATERIALS COST ADJUSTMENTS (BDE)**
Effective: November 2, 2006 Revised: August 1, 2017

**Description**. Bituminous material cost adjustments will be made to provide additional compensation to the Contractor, or credit to the Department, for fluctuations in the cost of bituminous materials when optioned by the Contractor. The bidder shall indicate with their bid whether or not this special provision will be part of the contract.

The adjustments shall apply to permanent and temporary hot-mix asphalt (HMA) mixtures, bituminous surface treatments (cover and seal coats), and preventative maintenance type surface treatments that are part of the original proposed construction, or added as extra work and paid for by agreed unit prices. The adjustments shall not apply to bituminous prime coats, tack coats, crack filling/sealing, joint filling/sealing, or extra work paid for at a lump sum price or by force account.

**Method of Adjustment**. Bituminous materials cost adjustments will be computed as follows.

$CA = (BPI_P - BPI_L) \times (\%AC_V / 100) \times Q$

Where: CA = Cost Adjustment, $.
$BPI_P$ = Bituminous Price Index, as published by the Department for the month the work is performed, $/ton ($/metric ton).
$BPI_L$ = Bituminous Price Index, as published by the Department for the month prior to the letting for work paid for at the contract price; or for the month the agreed unit price letter is submitted by the Contractor for extra work paid for by agreed unit price, $/ton ($/metric ton).
$\%AC_V$ = Percent of virgin Asphalt Cement in the Quantity being adjusted. For HMA mixtures, the % $AC_V$ will be determined from the adjusted job mix formula. For bituminous materials applied, a performance graded or cutback asphalt will be considered to be 100% $AC_V$ and undiluted emulsified asphalt will be considered to be 65% $AC_V$.
Q = Authorized construction Quantity, tons (metric tons) (see below).

For HMA mixtures measured in square yards: Q, tons = A x D x ($G_{mb}$ x 46.8) / 2000. For HMA mixtures measured in square meters: Q, metric tons = A x D x ($G_{mb}$ x 1) / 1000. When computing adjustments for full-depth HMA pavement, separate calculations will be made for the binder and surface courses to account for their different $G_{mb}$ and % $AC_V$.

For bituminous materials measured in gallons: Q, tons = V x 8.33 lb/gal x SG / 2000
For bituminous materials measured in liters: Q, metric tons = V x 1.0 kg/L x SG / 1000

Where: A = Area of the HMA mixture, sq yd (sq m).
D = Depth of the HMA mixture, in. (mm).
$G_{mb}$ = Average bulk specific gravity of the mixture, from the approved mix design.
V = Volume of the bituminous material, gal (L).
SG = Specific Gravity of bituminous material as shown on the bill of lading.

**Basis of Payment**. Bituminous materials cost adjustments may be positive or negative but will only be made when there is a difference between the $BPI_L$ and $BPI_P$ in excess of five percent, as calculated by:

$\text{Percent Difference} = \{(BPI_L - BPI_P) \div BPI_L\} \times 100$

Bituminous materials cost adjustments will be calculated for each calendar month in which applicable bituminous material is placed; and will be paid or deducted when all other contract requirements for the work placed during the month are satisfied. The adjustments shall not apply during contract time subject to liquidated damages for completion of the entire contract.

**COMPENSABLE DELAY COSTS (BDE)**
Effective: June 2, 2017 Revised: April 1, 2019

Revise Article 107.40(b) of the Standard Specifications to read:

"(b) Compensation. Compensation will not be allowed for delays, inconveniences, or damages sustained by the Contractor from conflicts with facilities not meeting the above definition; or if a conflict with a utility in an unanticipated location does not cause a shutdown of the work or a documentable reduction in the rate of progress exceeding the limits set herein. The provisions of Article 104.03 notwithstanding, compensation for delays caused by a utility in an unanticipated location will be paid according to the provisions of this Article governing minor and major delays or reduced rate of production which are defined as follows.

(1) Minor Delay. A minor delay occurs when the work in conflict with the utility in an unanticipated location is completely stopped for more than two hours, but not to exceed two weeks.

(2) Major Delay. A major delay occurs when the work in conflict with the utility in an unanticipated location is completely stopped for more than two weeks.

(3) Reduced Rate of Production Delay. A reduced rate of production delay occurs when the rate of production on the work in conflict with the utility in an unanticipated location decreases by more than 25 percent and lasts longer than seven calendar days."

Revise Article 107.40(c) of the Standard Specifications to read:

"(c) Payment. Payment for Minor, Major, and Reduced Rate of Production Delays will be made as follows.

(1) Minor Delay. Labor idled which cannot be used on other work will be paid for according to Article 109.04(b)(1) and (2) for the time between start of the delay and the minimum remaining hours in the work shift required by the prevailing practice in the area.

Equipment idled which cannot be used on other work, and which is authorized to standby on the project site by the Engineer, will be paid for according to Article 109.04(b)(4).

(2) Major Delay. Labor will be the same as for a minor delay.

Equipment will be the same as for a minor delay, except Contractor-owned equipment will be limited to two weeks plus the cost of move-out to either the Contractor's yard or another job and the cost to re-mobilize, whichever is less. Rental equipment may be paid for longer than two weeks provided the Contractor presents adequate support to the Department (including lease agreement) to show retaining equipment on the job is the most economical course to follow and in the public interest.

(3) Reduced Rate of Production Delay. The Contractor will be compensated for the reduced productivity for labor and equipment time in excess of the 25 percent threshold for that portion of the delay in excess of seven calendar days. Determination of compensation will be in accordance with Article 104.02, except labor and material additives will not be permitted.

Payment for escalated material costs, escalated labor costs, extended project overhead, and extended traffic control will be determined according to Article 109.13."

Revise Article 108.04(b) of the Standard Specifications to read:

"(b) No working day will be charged under the following conditions.

(1) When adverse weather prevents work on the controlling item.

(2) When job conditions due to recent weather prevent work on the controlling item.

(3) When conduct or lack of conduct by the Department or its consultants, representatives, officers, agents, or employees; delay by the Department in making the site available; or delay in furnishing any items required to be furnished to the Contractor by the Department prevents work on the controlling item.

(4) When delays caused by utility or railroad adjustments prevent work on the controlling item.

(5) When strikes, lock-outs, extraordinary delays in transportation, or inability to procure critical materials prevent work on the controlling item, as long as these delays are not due to any fault of the Contractor.

(6) When any condition over which the Contractor has no control prevents work on the controlling item."

Revise Article 109.09(f) of the Standard Specifications to read:

"(f) Basis of Payment. After resolution of a claim in favor of the Contractor, any adjustment in time required for the work will be made according to Section 108. Any adjustment in the costs to be paid will be made for direct labor, direct materials, direct equipment, direct jobsite overhead, direct offsite overhead, and other direct costs allowed by the resolution. Adjustments in costs will not be made for interest charges, loss of anticipated profit, undocumented loss of efficiency, home office overhead and unabsorbed overhead other than as allowed by Article 109.13, lost opportunity, preparation of claim expenses and other consequential indirect costs regardless of method of calculation.

The above Basis of Payment is an essential element of the contract and the claim cost recovery of the Contractor shall be so limited."

Add the following to Section 109 of the Standard Specifications.

"**109.13 Payment for Contract Delay.** Compensation for escalated material costs, escalated labor costs, extended project overhead, and extended traffic control will be allowed when such costs result from a delay meeting the criteria in the following table.

| Contract Type | Cause of Delay | Length of Delay |
|---|---|---|
| Working Days | Article 108.04(b)(3) or Article 108.04(b)(4) | No working days have been charged for two consecutive weeks. |
| Completion Date | Article 108.08(b)(1) or Article 108.08(b)(7) | The Contractor has been granted a minimum two week extension of contract time, according to Article 108.08. |

Payment for each of the various costs will be according to the following.

(a) Escalated Material and/or Labor Costs. When the delay causes work, which would have otherwise been completed, to be done after material and/or labor costs have increased, such increases will be paid. Payment for escalated material costs will be limited to the increased costs substantiated by documentation furnished by the Contractor. Payment for escalated labor costs will be limited to those items in Article 109.04(b)(1) and (2), except the 35 percent and 10 percent additives will not be permitted.

(b) Extended Project Overhead. For the duration of the delay, payment for extended project overhead will be paid as follows.

(1) Direct Jobsite and Offsite Overhead. Payment for documented direct jobsite overhead and documented direct offsite overhead, including onsite supervisory and administrative personnel, will be allowed according to the following table.

| Original Contract Amount | Supervisory and Administrative Personnel |
|---|---|
| Up to $5,000,000 | One Project Superintendent |
| Over $ 5,000,000 - up to $25,000,000 | One Project Manager, One Project Superintendent or Engineer, and One Clerk |
| Over $25,000,000 - up to $50,000,000 | One Project Manager, One Project Superintendent, One Engineer, and One Clerk |
| Over $50,000,000 | One Project Manager, Two Project Superintendents, One Engineer, and One Clerk |

(2) Home Office and Unabsorbed Overhead. Payment for home office and unabsorbed overhead will be calculated as 8 percent of the total delay cost.

(c) Extended Traffic Control. Traffic control required for an extended period of time due to the delay will be paid for according to Article 109.04.

When an extended traffic control adjustment is paid under this provision, an adjusted unit price as provided for in Article 701.20(a) for increase or decrease in the value of work by more than ten percent will not be paid.

Upon payment for a contract delay under this provision, the Contractor shall assign subrogation rights to the Department for the Department's efforts of recovery from any other party for monies paid by the Department as a result of any claim under this provision. The Contractor shall fully cooperate with the Department in its efforts to recover from another party any money paid to the Contractor for delay damages under this provision."

**CONCRETE END SECTIONS FOR PIPE CULVERTS (BDE)**
Effective: January 1, 2013 Revised: April 1, 2016

**Description**. This work shall consist of constructing cast-in-place concrete and precast concrete end sections for pipe culverts. These end sections are shown on the plans as Highway Standard 542001 or 542011. This work shall be according to Section 542 of the Standard Specifications except as modified herein.

**Materials**. Materials shall be according to the following Articles of Division 1000 – Materials of the Standard Specifications.

| Item | Article/Section |
|---|---|
| (a) Portland Cement Concrete (Note 1) | 1020 |
| (b) Precast Concrete End Sections (Note 2) | |
| (c) Coarse Aggregate (Note 3) | 1004.05 |
| (d) Structural Steel (Note 4) | 1006.04 |
| (e) Anchor Bolts and Rods (Note 5) | 1006.09 |
| (f) Reinforcement Bars | 1006.10(a) |
| (g) Nonshrink Grout | 1024.02 |
| (h) Chemical Adhesive Resin System | 1027 |
| (i) Mastic Joint Sealer for Pipe | 1055 |
| (j) Hand Hole Plugs | 1042.16 |

Note 1. Cast-in-place concrete end sections shall be Class SI, except the 14 day mix design shall have a compressive strength of 5000 psi (34,500 kPa) or a flexural strength of (800 psi) 5500 kPa and a minimum cement factor of 6.65 cwt/cu yd (395 kg/cu m).

Note 2. Precast concrete end sections shall be according to Articles 1042.02 and 1042.03(b)(c)(d)(e) of the Standard Specifications. The concrete shall be Class PC according to Section 1020, and shall have a minimum compressive strength of 5000 psi (34,000 kPa) at 28 days.

Joints between precast sections shall be produced with reinforced tongue and groove ends according to the requirements of ASTM C 1577.

Note 3. The granular bedding placed below a precast concrete end section shall be gradation CA 6, CA 9, CA 10, CA 12, CA 17, CA 18, or CA 19.

Note 4. All components of the culvert tie detail shall be galvanized according to the requirements of AASHTO M 111 or M 232 as applicable.

Note 5. The anchor rods for the culvert ties shall be according to the requirements of ASTM F 1554, Grade 105 (Grade 725).

## CONSTRUCTION REQUIREMENTS

The concrete end sections may be precast or cast-in-place construction. Toe walls shall be either precast or cast-in-place, and shall be in proper position and backfilled according to the applicable paragraphs of Article 502.10 of the Standard Specifications prior to the installation of the concrete end sections. If soil conditions permit, cast-in-place toe walls may be poured directly against the soil. When poured directly against the soil, the clear cover of the sides and bottom of the toe wall shall be increased to 3 in. (75 mm) by increasing the thickness of the toe wall.

(a) Cast-In-Place Concrete End Sections. Cast-in-place concrete end sections shall be constructed according to the requirements of Section 503 of the Standard Specifications and as shown on the plans.

(b) Precast Concrete End Sections. When the concrete end sections will be precast, shop drawings detailing the slab thickness and reinforcement layout shall be submitted to the Engineer for review and approval.

The excavation and backfilling for precast concrete end sections shall be according to the requirements of Section 502 of the Standard Specifications, except a layer of granular bedding at least 6 in. (150 mm) in thickness shall be placed below the elevation of the bottom of the end section. The granular bedding shall extend a minimum of 2 ft (600 mm) beyond each side of the end section.

Anchor rods connecting precast sections shall be brought to a snug tight condition followed by an additional 2/3 turn on one of the nuts. Match marks shall be provided on the bolt and nut to verify relative rotation between the bolt and the nut.

When individual, precast end sections are placed side-by-side for a multi-pipe culvert installation, a 3 in. (75 mm) space shall be left between adjacent end section walls and the space(s) filled with Class SI concrete.

**Method of Measurement**. This work will be measured for payment as each, with each end of each culvert being one each.

**Basis of Payment**. This work will be paid for at the contract unit price per each for CONCRETE END SECTION, STANDARD 542001 or CONCRETE END SECTION, 542011, of the pipe diameter and slope specified.

## CONSTRUCTION AIR QUALITY – DIESEL RETROFIT (BDE)

Effective: June 1, 2010 Revised: November 1, 2014

The reduction of emissions of particulate matter (PM) for off-road equipment shall be accomplished by installing retrofit emission control devices. The term “equipment” refers to diesel fuel powered devices rated at 50 hp and above, to be used on the jobsite in excess of seven calendar days over the course of the construction period on the jobsite (including rental equipment).

Contractor and subcontractor diesel powered off-road equipment assigned to the contract shall be retrofitted using the phased in approach shown below. Equipment that is of a model year older than the year given for that equipment's respective horsepower range shall be retrofitted:

| Effective Dates | Horsepower Range | Model Year |
|---|---|---|
| | | |
| June 1, 2010 1/ | 600-749 | 2002 |
| | 750 and up | 2006 |
| | | |
| June 1, 2011 2/ | 100-299 | 2003 |
| | 300-599 | 2001 |
| | 600-749 | 2002 |
| | 750 and up | 2006 |
| | | |
| June 1, 2012 2/ | 50-99 | 2004 |
| | 100-299 | 2003 |
| | 300-599 | 2001 |
| | 600-749 | 2002 |
| | 750 and up | 2006 |

1/ Effective dates apply to Contractor diesel powered off-road equipment assigned to the contract.

2/ Effective dates apply to Contractor and subcontractor diesel powered off-road equipment assigned to the contract.

The retrofit emission control devices shall achieve a minimum PM emission reduction of 50 percent and shall be:

a) Included on the U.S. Environmental Protection Agency (USEPA) *Verified Retrofit Technology List* (http://www.epa.gov/cleandiesel/verification/verif-list.htm), or verified by the California Air Resources Board (CARB) (http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm); or

b) Retrofitted with a non-verified diesel retrofit emission control device if verified retrofit emission control devices are not available for equipment proposed to be used on the project, and if the Contractor has obtained a performance certification from the retrofit device manufacturer that the emission control device provides a minimum PM emission reduction of 50 percent.

Note: Large cranes (Crawler mounted cranes) which are responsible for critical lift operations are exempt from installing retrofit emission control devices if such devices adversely affect equipment operation.

Diesel powered off-road equipment with engine ratings of 50 hp and above, which are unable to be retrofitted with verified emission control devices or if performance certifications are not available which will achieve a minimum 50 percent PM reduction, may be granted a waiver by the Department if documentation is provided showing good faith efforts were made by the Contractor to retrofit the equipment.

Construction shall not proceed until the Contractor submits a certified list of the diesel powered off-road equipment that will be used, and as necessary, retrofitted with emission control devices. The list(s) shall include (1) the equipment number, type, make, Contractor/rental company name; and (2) the emission control devices make, model, USEPA or CARB verification number, or performance certification from the retrofit device manufacturer. Equipment reported as fitted with emissions control devices shall be made available to the Engineer for visual inspection of the device installation, prior to being used on the jobsite.

The Contractor shall submit an updated list of retrofitted off-road construction equipment as retrofitted equipment changes or comes on to the jobsite. The addition or deletion of any diesel powered equipment shall be included on the updated list.

If any diesel powered off-road equipment is found to be in non-compliance with any portion of this special provision, the Engineer will issue the Contractor a diesel retrofit deficiency deduction.

Any costs associated with retrofitting any diesel powered off-road equipment with emission control devices shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed. The Contractor's compliance with this notice and any associated regulations shall not be grounds for a claim.

**Diesel Retrofit Deficiency Deduction**

When the Engineer determines that a diesel retrofit deficiency exists, a daily monetary deduction will be imposed for each calendar day or fraction thereof the deficiency continues to exist. The calendar day(s) will begin when the time period for correction is exceeded and end with the Engineer's written acceptance of the correction. The daily monetary deduction will be $1,000.00 for each deficiency identified.

The deficiency will be based on lack of diesel retrofit emissions control.

If a Contractor accumulates three diesel retrofit deficiency deductions for the same piece of equipment in a contract period, the Contractor will be shutdown until the deficiency is corrected. Such a shutdown will not be grounds for any extension of the contract time, waiver of penalties, or be grounds for any claim.

**DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION (BDE)**
Effective: September 1, 2000 Revised: March 2, 2019

FEDERAL OBLIGATION. The Department of Transportation, as a recipient of federal financial assistance, is required to take all necessary and reasonable steps to ensure nondiscrimination in the award and administration of contracts. Consequently, the federal regulatory provisions of 49 CFR Part 26 apply to this contract concerning the utilization of disadvantaged business enterprises. For the purposes of this Special Provision, a disadvantaged business enterprise (DBE) means a business certified by the Department in accordance with the requirements of 49 CFR Part 26 and listed in the Illinois Unified Certification Program (IL UCP) DBE Directory.

STATE OBLIGATION. This Special Provision will also be used by the Department to satisfy the requirements of the Business Enterprise for Minorities, Females, and Persons with Disabilities Act, 30 ILCS 575. When this Special Provision is used to satisfy state law requirements on 100 percent state-funded contracts, the federal government has no involvement in such contracts (not a federal-aid contract) and no responsibility to oversee the implementation of this Special Provision by the Department on those contracts. DBE participation on 100 percent state-funded contracts will not be credited toward fulfilling the Department's annual overall DBE goal required by the US Department of Transportation to comply with the federal DBE program requirements.

CONTRACTOR ASSURANCE. The Contractor makes the following assurance and agrees to include the assurance in each subcontract the Contractor signs with a subcontractor.

The Contractor, subrecipient, or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of contracts funded in whole or in part with federal or state funds. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate, which may include, but is not limited to:

(a) Withholding progress payments;

(b) Assessing sanctions;

(c) Liquidated damages; and/or

(d) Disqualifying the Contractor from future bidding as non-responsible.

OVERALL GOAL SET FOR THE DEPARTMENT. As a requirement of compliance with 49 CFR Part 26, the Department has set an overall goal for DBE participation in its federally assisted contracts. That goal applies to all federal-aid funds the Department will expend in its federally assisted contracts for the subject reporting fiscal year. The Department is required to make a good faith effort to achieve the overall goal. The dollar amount paid to all approved DBE companies performing work called for in this contract is eligible to be credited toward fulfillment of the Department's overall goal.

CONTRACT GOAL TO BE ACHIEVED BY THE CONTRACTOR. This contract includes a specific DBE utilization goal established by the Department. The goal has been included because the Department has determined the work of this contract has subcontracting opportunities that may be suitable for performance by DBE companies. The determination is based on an assessment of the type of work, the location of the work, and the availability of DBE companies to do a part of the work. The assessment indicates, in the absence of unlawful discrimination and in an arena of fair and open competition, DBE companies can be expected to perform **11.00%** of the work. This percentage is set as the DBE participation goal for this contract. Consequently, in addition to the other award criteria established for this contract, the Department will only award this contract to a bidder who makes a good faith effort to meet this goal of DBE participation in the performance of the work. A bidder makes a good faith effort for award consideration if either of the following is done in accordance with the procedures set for in this Special Provision:

(a) The bidder documents enough DBE participation has been obtained to meet the goal or,

(b) The bidder documents a good faith effort has been made to meet the goal, even though the effort did not succeed in obtaining enough DBE participation to meet the goal.

DBE LOCATOR REFERENCES. Bidders shall consult the IL UCP DBE Directory as a reference source for DBE-certified companies. In addition, the Department maintains a letting and item specific DBE locator information system whereby DBE companies can register their interest in providing quotes on particular bid items advertised for letting. Information concerning DBE companies willing to quote work for particular contracts may be obtained by contacting the Department's Bureau of Small Business Enterprises at telephone number (217) 785-4611, or by visiting the Department's website at:
http://www.idot.illinois.gov/doing-business/certifications/disadvantaged-business-enterprise-certification/il-ucp-directory/index.

BIDDING PROCEDURES. Compliance with this Special Provision is a material bidding requirement and failure of the bidder to comply will render the bid not responsive.

The bidder shall submit a DBE Utilization Plan (form SBE 2026), and a DBE Participation Statement (form SBE 2025) for each DBE company proposed for the performance of work to achieve the contract goal, with the bid. If the Utilization Plan indicates the contract goal will not be met, documentation of good faith efforts shall also be submitted. The documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor is selected over a DBE for work on the contract. The required forms and documentation must be submitted as a single .pdf file using the "Integrated Contractor Exchange (iCX)" application within the Department's "EBids System".

The Department will not accept a Utilization Plan if it does not meet the bidding procedures set forth herein and the bid will be declared not responsive. In the event the bid is declared not responsive, the Department may elect to cause the forfeiture of the penal sum of the bidder's proposal guaranty and may deny authorization to bid the project if re-advertised for bids.

GOOD FAITH EFFORT PROCEDURES. The contract will not be awarded until the Utilization Plan is approved. All information submitted by the bidder must be complete, accurate and adequately document enough DBE participation has been obtained or document the good faith efforts of the bidder, in the event enough DBE participation has not been obtained, before the Department will commit to the performance of the contract by the bidder. The Utilization Plan will be approved by the Department if the Utilization Plan documents sufficient commercially useful DBE work to meet the contract goal or the bidder submits sufficient documentation of a good faith effort to meet the contract goal pursuant to 49 CFR Part 26, Appendix A. This means the bidder must show that all necessary and reasonable steps were taken to achieve the contract goal. Necessary and reasonable steps are those which, by their scope, intensity and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if they were not successful. The Department will consider the quality, quantity, and intensity of the kinds of efforts the bidder has made. Mere *pro forma* efforts, in other words efforts done as a matter of form, are not good faith efforts; rather, the bidder is expected to have taken genuine efforts that would be reasonably expected of a bidder actively and aggressively trying to obtain DBE participation sufficient to meet the contract goal.

(a) The following is a list of types of action that the Department will consider as part of the evaluation of the bidder's good faith efforts to obtain participation. These listed factors are not intended to be a mandatory checklist and are not intended to be exhaustive. Other factors or efforts brought to the attention of the Department may be relevant in appropriate cases and will be considered by the Department.

(1) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising and/or written notices) the interest of all certified DBE companies that have the capability to perform the work of the contract. The bidder must solicit this interest within sufficient time to allow the DBE companies to respond to the solicitation. The bidder must determine with certainty if the DBE companies are interested by taking appropriate steps to follow up initial solicitations.

(2) Selecting portions of the work to be performed by DBE companies in order to increase the likelihood that the DBE goals will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the Contractor might otherwise prefer to perform these work items with its own forces.

(3) Providing interested DBE companies with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.

(4) a. Negotiating in good faith with interested DBE companies. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBE companies that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBE companies to perform the work.

b. A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBE companies is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also the ability or desire of a bidder to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidders are not, however, required to accept higher quotes from DBE companies if the price difference is excessive or unreasonable. In accordance with the above Bidding Procedures, the documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor was selected over a DBE for work on the contract.

(5) Not rejecting DBE companies as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.

(6) Making efforts to assist interested DBE companies in obtaining bonding, lines of credit, or insurance as required by the recipient or Contractor.

(7) Making efforts to assist interested DBE companies in obtaining necessary equipment, supplies, materials, or related assistance or services.

(8) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBE companies.

(b) If the Department determines the bidder has made a good faith effort to secure the work commitment of DBE companies to meet the contract goal, the Department will award the contract provided it is otherwise eligible for award. If the Department determines the bidder has failed to meet the requirements of this Special Provision or that a good faith effort has not been made, the Department will notify the responsible company official designated in the Utilization Plan that the bid is not responsive. The notification will also include a statement of reasons for the adverse determination. If the Utilization Plan is not approved because it is deficient as a technical matter, unless waived by the Department, the bidder will be notified and will be allowed no more than a five calendar day period to cure the deficiency.

(c) The bidder may request administrative reconsideration of an adverse determination by emailing the Department at "DOT.DBE.UP@illinois.gov" within the five calendar days after the receipt of the notification of the determination. The determination shall become final if a request is not made on or before the fifth calendar day. A request may provide additional written documentation or argument concerning the issues raised in the determination statement of reasons, provided the documentation and arguments address efforts made prior to submitting the bid. The request will be reviewed by the Department's Reconsideration Officer. The Reconsideration Officer will extend an opportunity to the bidder to meet in person to consider all issues of documentation and whether the bidder made a good faith effort to meet the goal. After the review by the Reconsideration Officer, the bidder will be sent a written decision within ten working days after receipt of the request for reconsideration, explaining the basis for finding that the bidder did or did not meet the goal or make adequate good faith efforts to do so. A final decision by the Reconsideration Officer that a good faith effort was made shall approve the Utilization Plan submitted by the bidder and shall clear the contract for award. A final decision that a good faith effort was not made shall render the bid not responsive.

CALCULATING DBE PARTICIPATION. The Utilization Plan values represent work anticipated to be performed and paid for upon satisfactory completion. The Department is only able to count toward the achievement of the overall goal and the contract goal the value of payments made for the work actually performed by DBE companies. In addition, a DBE must perform a commercially useful function on the contract to be counted. A commercially useful function is generally performed when the DBE is responsible for the work and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. The Department and Contractor are governed by the provisions of 49 CFR Part 26.55(c) on questions of commercially useful functions as it affects the work. Specific counting guidelines are provided in 49 CFR Part 26.55, the provisions of which govern over the summary contained herein.

(a) DBE as the Contractor: 100 percent goal credit for that portion of the work performed by the DBE's own forces, including the cost of materials and supplies. Work that a DBE subcontracts to a non-DBE does not count toward the DBE goals.

(b) DBE as a joint venture Contractor: 100 percent goal credit for that portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work performed by the DBE's own forces.

(c) DBE as a subcontractor: 100 percent goal credit for the work of the subcontract performed by the DBE's own forces, including the cost of materials and supplies, excluding the purchase of materials and supplies or the lease of equipment by the DBE subcontractor from the Contractor or its affiliates. Work that a DBE subcontractor in turn subcontracts to a non-DBE does not count toward the DBE goal.

(d) DBE as a trucker: 100 percent goal credit for trucking participation provided the DBE is responsible for the management and supervision of the entire trucking operation for which it is responsible. At least one truck owned, operated, licensed, and insured by the DBE must be used on the contract. Credit will be given for the following:

(1) The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract.

(2) The DBE may also lease trucks from a non-DBE firm, including from an owner-operator. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission is receives as a result of the lease arrangement.

(e) DBE as a material supplier:

(1) 60 percent goal credit for the cost of the materials or supplies purchased from a DBE regular dealer.

(2) 100 percent goal credit for the cost of materials of supplies obtained from a DBE manufacturer.

(3) 100 percent credit for the value of reasonable fees and commissions for the procurement of materials and supplies if not a DBE regular dealer or DBE manufacturer.

CONTRACT COMPLIANCE. Compliance with this Special Provision is an essential part of the contract. The Department is prohibited by federal regulations from crediting the participation of a DBE included in the Utilization Plan toward either the contract goal or the Department's overall goal until the amount to be applied toward the goals has been paid to the DBE. The following administrative procedures and remedies govern the compliance by the Contractor with the contractual obligations established by the Utilization Plan. After approval of the Utilization Plan and award of the contract, the Utilization Plan and individual DBE Participation Statements become part of the contract. If the Contractor did not succeed in obtaining enough DBE participation to achieve the advertised contract goal, and the Utilization Plan was approved and contract awarded based upon a determination of good faith, the total dollar value of DBE work calculated in the approved Utilization Plan as a percentage of the awarded contract value shall become the amended contract goal. All work indicated for performance by an approved DBE shall be performed, managed, and supervised by the DBE executing the DBE Participation Commitment Statement.

(a) NO AMENDMENT. No amendment to the Utilization Plan may be made without prior written approval from the Department's Bureau of Small Business Enterprises. All requests for amendment to the Utilization Plan shall be emailed to the Department at DOT.DBE.UP@illinois.gov.

(b) CHANGES TO WORK. Any deviation from the DBE condition-of-award or contract plans, specifications, or special provisions must be approved, in writing, by the Department as provided elsewhere in the Contract. The Contractor shall notify affected DBEs in writing of any changes in the scope of work which result in a reduction in the dollar amount condition-of-award to the contract. Where the revision includes work committed to a new DBE subcontractor, not previously involved in the project, then a Request for Approval of Subcontractor, Department form BC 260A or AER 260A, must be signed and submitted. If the commitment of work is in the form of additional tasks assigned to an existing subcontract, a new Request for Approval of Subcontractor will not be required. However, the Contractor must document efforts to assure the existing DBE subcontractor is capable of performing the additional work and has agreed in writing to the change.

(c) SUBCONTRACT. The Contractor must provide copies of DBE subcontracts to the Department upon request. Subcontractors shall ensure that all lower tier subcontracts or agreements with DBEs to supply labor or materials be performed in accordance with this Special Provision.

(d) ALTERNATIVE WORK METHODS. In addition to the above requirements for reductions in the condition of award, additional requirements apply to the two cases of Contractor-initiated work substitution proposals. Where the contract allows alternate work methods which serve to delete or create underruns in condition of award DBE work, and the Contractor selects that alternate method or, where the Contractor proposes a substitute work method or material that serves to diminish or delete work committed to a DBE and replace it with other work, then the Contractor must demonstrate one of the following:

(1) The replacement work will be performed by the same DBE (as long as the DBE is certified in the respective item of work) in a modification of the condition of award; or

(2) The DBE is aware its work will be deleted or will experience underruns and has agreed in writing to the change. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so; or

(3) The DBE is not capable of performing the replacement work or has declined to perform the work at a reasonable competitive price. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so.

(e) TERMINATION AND REPLACEMENT PROCEDURES. The Contractor shall not terminate or replace a DBE listed on the approved Utilization Plan, or perform with other forces work designated for a listed DBE except as provided in this Special Provision. The Contractor shall utilize the specific DBEs listed to perform the work and supply the materials for which each is listed unless the Contractor obtains the Department's written consent as provided in subsection (a) of this part. Unless Department consent is provided for termination of a DBE subcontractor, the Contractor shall not be entitled to any payment for work or material unless it is performed or supplied by the DBE in the Utilization Plan.

As stated above, the Contractor shall not terminate or replace a DBE subcontractor listed in the approved Utilization Plan without prior written consent. This includes, but is not limited to, instances in which the Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm. Written consent will be granted only if the Bureau of Small Business Enterprises agrees, for reasons stated in its concurrence document, that the Contractor has good cause to terminate or replace the DBE firm. Before transmitting to the Bureau of Small Business Enterprises any request to terminate and/or substitute a DBE subcontractor, the Contractor shall give notice in writing to the DBE subcontractor, with a copy to the Bureau, of its intent to request to terminate and/or substitute, and the reason for the request. The Contractor shall give the DBE five days to respond to the Contractor's notice. The DBE so notified shall advise the Bureau and the Contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why the Bureau should not approve the Contractor's action. If required in a particular case as a matter of public necessity, the Bureau may provide a response period shorter than five days.

For purposes of this paragraph, good cause includes the following circumstances:

(1) The listed DBE subcontractor fails or refuses to execute a written contract;

(2) The listed DBE subcontractor fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Provided, however, that good cause does not exist if the failure or refusal of the DBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the Contractor;

(3) The listed DBE subcontractor fails or refuses to meet the Contractor's reasonable, nondiscriminatory bond requirements;

(4) The listed DBE subcontractor becomes bankrupt, insolvent, or exhibits credit unworthiness;

(5) The listed DBE subcontractor is ineligible to work on public works projects because of suspension and debarment proceedings pursuant 2 CFR Parts 180, 215 and 1200 or applicable state law.

(6) The Contractor has determined the listed DBE subcontractor is not a responsible contractor;

(7) The listed DBE subcontractor voluntarily withdraws from the projects and provides written notice to the Contractor of its withdrawal;

(8) The listed DBE is ineligible to receive DBE credit for the type of work required;

(9) A DBE owner dies or becomes disabled with the result that the listed DBE subcontractor is unable to complete its work on the contract;

(10) Other documented good cause that compels the termination of the DBE subcontractor. Provided, that good cause does not exist if the Contractor seeks to terminate a DBE it relied upon to obtain the contract so that the Contractor can self-perform the work for which the DBE contractor was engaged or so that the Contractor can substitute another DBE or non-DBE contractor after contract award.

When a DBE is terminated or fails to complete its work on the Contract for any reason, the Contractor shall make a good faith effort to find another DBE to substitute for the original DBE to perform at least the same amount of work under the contract as the terminated DBE to the extent needed to meet the established Contract goal. The good faith efforts shall be documented by the Contractor. If the Department requests documentation under this provision, the Contractor shall submit the documentation within seven days, which may be extended for an additional seven days if necessary at the request of the Contractor. The Department will provide a written determination to the Contractor stating whether or not good faith efforts have been demonstrated.

(f) FINAL PAYMENT. After the performance of the final item of work or delivery of material by a DBE and final payment therefore to the DBE by the Contractor, but not later than 30 calendar days after payment has been made by the Department to the Contractor for such work or material, the Contractor shall submit a DBE Payment Agreement on Department form SBE 2115 to the Resident Engineer. If full and final payment has not been made to the DBE, the DBE Payment Agreement shall indicate whether a disagreement as to the payment required exists between the Contractor and the DBE or if the Contractor believes the work has not been satisfactorily completed. If the Contractor does not have the full amount of work indicated in the Utilization Plan performed by the DBE companies indicated in the Utilization Plan and after good faith efforts are reviewed, the Department may deduct from contract payments to the Contractor the amount of the goal not achieved as liquidated and ascertained damages. The Contractor may request an administrative reconsideration of any amount deducted as damages pursuant to subsection (h) of this part.

(g) ENFORCEMENT. The Department reserves the right to withhold payment to the Contractor to enforce the provisions of this Special Provision. Final payment shall not be made on the contract until such time as the Contractor submits sufficient documentation demonstrating achievement of the goal in accordance with this Special Provision or after liquidated damages have been determined and collected.

(h) RECONSIDERATION. Notwithstanding any other provision of the contract, including but not limited to Article 109.09 of the Standard Specifications, the Contractor may request administrative reconsideration of a decision to deduct the amount of the goal not achieved as liquidated damages. A request to reconsider shall be delivered to the Contract Compliance Section and shall be handled and considered in the same manner as set forth in paragraph (c) of "Good Faith Effort Procedures" of this Special Provision, except a final decision that a good faith effort was not made during contract performance to achieve the goal agreed to in the Utilization Plan shall be the final administrative decision of the Department. The result of the reconsideration process is not administratively appealable to the U.S. Department of Transportation.

**DISPOSAL FEES (BDE)**
Effective: November 1, 2018

Replace Articles 109.04(b)(5) – 109.04(b)(8) of the Standard Specifications with the following:

"(5) Disposal Fees. When the extra work performed includes paying for disposal fees at a clean construction and demolition debris facility, an uncontaminated soil fill operation or a landfill, the Contractor shall receive, as administrative costs, an amount equal to five percent of the first $10,000 and one percent of any amount over $10,000 of the total approved costs of such fees.

(6) Miscellaneous. No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.

(7) Statements. No payment will be made for work performed on a force account basis until the Contractor has furnished the Engineer with itemized statements of the cost of such force account work. Statements shall be accompanied and supported by invoices for all materials used and transportation charges. However, if materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then in lieu of the invoices, the Contractor shall furnish an affidavit certifying that such materials were taken from his/her stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

Itemized statements at the cost of force account work shall be detailed as follows.

a. Name, classification, date, daily hours, total hours, rate, and extension for each laborer and foreman. Payrolls shall be submitted to substantiate actual wages paid if so requested by the Engineer.

b. Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.

c. Quantities of materials, prices and extensions.

d. Transportation of materials.

e. Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions, and social security tax.

(8) Work Performed by an Approved Subcontractor. When extra work is performed by an approved subcontractor, the Contractor shall receive, as administrative costs, an amount equal to five percent of the total approved costs of such work with the minimum payment being $100.

(9) All statements of the cost of force account work shall be furnished to the Engineer not later than 60 days after receipt of the Central Bureau of Construction form "Extra Work Daily Report". If the statement is not received within the specified time frame, all demands for payment for the extra work are waived and the Department is released from any and all such demands. It is the responsibility of the Contractor to ensure that all statements are received within the specified time regardless of the manner or method of delivery."

**EMULSIFIED ASPHALTS (BDE)**
Effective: August 1, 2019

Revise Article 1032.06 of the Standard Specifications to read:

"**1032.06 Emulsified Asphalts.** Emulsified asphalts will be accepted according to the current Bureau of Materials Policy Memorandum, "Emulsified Asphalt Acceptance Procedure". These materials shall be homogeneous and shall show no separation of asphalt after thorough mixing, within 30 days after delivery, provided separation has not been caused by freezing. They shall coat the aggregate being used in the work to the satisfaction of the Engineer and shall be according to the following requirements.

a) Anionic Emulsified Asphalt. Anionic emulsified asphalts RS-1, RS-2, HFRS-2, SS-1h, and SS-1 shall be according to AASHTO M 140, except as follows.

(1) The cement mixing test will be waived when the emulsion is being used as a tack coat.

(2) The Solubility in Trichloroethylene test according to AASHTO T 44 may be run in lieu of Ash Content and shall meet a minimum of 97.5 percent.

b) Cationic Emulsified Asphalt. Cationic emulsified asphalts CRS-1, CRS-2, CSS-1h, and CSS-1 shall be according to AASHTO M 208, except as follows.

(1) The cement mixing test will be waived when the emulsion is being used as a tack coat.

(2) The Solubility in Trichloroethylene test according to AASHTO T 44 may be run in lieu of Ash Content and shall meet a minimum of 97.5 percent.

c) High Float Emulsion. High float emulsions HFE-90, HFE-150, and HFE-300 are medium setting and shall be according to the following table.

| Test | HFE-90 | HFE-150 | HFE-300 |
|---|---|---|---|
| Viscosity, Saybolt Furol, at 122 °F (50 °C), (AASHTO T 59), SFS [1/] | 50 min. | 50 min. | 50 min. |
| Sieve Test, No. 20 (850 µm), retained on sieve, (AASHTO T 59), % | 0.10 max. | 0.10 max. | 0.10 max. |
| Storage Stability Test, 1 day, (AASHTO T 59), % | 1 max. | 1 max. | 1 max. |
| Coating Test (All Grades), (AASHTO T 59), 3 minutes | stone coated thoroughly | | |
| Distillation Test, (AASHTO T 59): Residue from distillation test to 500 °F (260 °C), % Oil distillate by volume, % | 65 min. 7 max. | 65 min. 7 max. | 65 min. 7 max. |
| Characteristics of residue from distillation test to 500 °F (260 °C): Penetration at 77 °F (25 °C), (AASHTO T 49), 100 g, 5 sec, dmm | 90-150 | 150-300 | 300 min. |
| Float Test at 140 °F (60 °C), (AASHTO T 50), sec. | 1200 min. | 1200 min. | 1200 min. |

1/ The emulsion shall be pumpable.

(d) Penetrating Emulsified Prime. Penetrating Emulsified Prime (PEP) shall be according to AASHTO T 59, except as follows.

| Test | Result |
|---|---|
| Viscosity, Saybolt Furol, at 77 °F (25 °C), SFS | 75 max. |
| Sieve test, retained on No. 20 (850 µm) sieve, % | 0.10 max. |
| Distillation to 500 °F (260 °C) residue, % | 38 min. |
| Oil distillate by volume, % | 4 max. |

The PEP shall be tested according to the current Bureau of Materials Illinois Laboratory Test Procedure (ILTP), "Sand Penetration Test of Penetrating Emulsified Prime (PEP)". The time of penetration shall be equal to or less than that of MC-30. The depth of penetration shall be equal to or greater than that of MC-30.

(e) Delete this subparagraph.

(f) Polymer Modified Emulsified Asphalt. Polymer modified emulsified asphalts, e.g. SS-1hP, CSS-1hP, CRS-2P (formerly CRSP), CQS-1hP (formerly CSS-1h Latex Modified) and HFRS-2P (formerly HFP) shall be according to AASHTO M 316, except as follows.

(1) The cement mixing test will be waived when the polymer modified emulsion is being used as a tack coat.

(2) CQS-1hP (formerly CSS-1h Latex Modified) emulsion for micro-surfacing treatments shall use latex as the modifier.

(3) Upon examination of the storage stability test cylinder after standing undisturbed for 24 hours, the surface shall show minimal to no white, milky colored substance and shall be a homogenous brown color throughout.

(4) The distillation for all polymer modified emulsions shall be performed according to AASHTO T 59, except the temperature shall be 374 ± 9 °F (190 ± 5 °C) to be held for a period of 15 minutes and measured using an ASTM 16F (16C) thermometer.

(5) The specified temperature for the Elastic Recovery test for all polymer modified emulsions shall be 50.0 ± 1.0 °F (10.0 ± 0.5 °C).

(6) The Solubility in Trichloroethylene test according to AASHTO T 44 may be run in lieu of Ash Content and shall meet a minimum of 97.5 percent.

(g) Non-Tracking Emulsified Asphalt. Non-tracking emulsified asphalt NTEA (formerly SS-1vh) shall be according to the following.

| Test | Requirement |
|---|---|
| Saybolt Viscosity at 77 °F (25 °C), (AASHTO T 59), SFS | 20-100 |
| Storage Stability Test, 24 hr, (AASHTO T 59), % | 1 max. |
| Residue by Distillation, 500 ± 10 °F (260 ± 5 °C), or Residue by Evaporation, 325 ± 5 °F (163 ± 3 °C), (AASHTO T 59), % | 50 min. |
| Sieve Test, No. 20 (850 µm), (AASHTO T 59), % | 0.3 max. |
| Tests on Residue from Evaporation | |
| Penetration at 77 °F (25 °C), 100 g, 5 sec, (AASHTO T 49), dmm | 40 max. |
| Softening Point, (AASHTO T 53), °F (°C) | 135 (57) min. |
| Ash Content, (AASHTO T 111), % 1/ | 1 max. |

1/ The Solubility in Trichloroethylene test according to AASHTO T 44 may be run in lieu of Ash Content and shall meet a minimum of 97.5 percent

The different grades are, in general, used for the following.

| Grade | Use |
|---|---|
| SS-1, SS-1h, RS-1, RS-2, CSS-1, CRS-1, CRS-2, CSS-1h, HFE-90, SS-1hP, CSS-1hP, NTEA (formerly SS-1vh) | Tack Coat |
| PEP | Prime Coat |
| RS-2, HFE-90, HFE-150, HFE-300, CRS-2P (formerly CRSP), HFRS-2P (formerly HFP), CRS-2, HFRS-2 | Bituminous Surface Treatment |
| CQS-1hP (formerly CSS-1h Latex Modified) | Micro-Surfacing<br>Slurry Sealing<br>Cape Seal" |

**EQUIPMENT PARKING AND STORAGE (BDE)**
Effective: November 1, 2017

Replace the first paragraph of Article 701.11 of the Standard Specifications with the following.

"**701.11 Equipment Parking and Storage.** During working hours, all vehicles and/or nonoperating equipment which are parked, two hours or less, shall be parked at least 8 ft (2.5 m) from the open traffic lane. For other periods of time during working and for all nonworking hours, all vehicles, materials, and equipment shall be parked or stored as follows.

(a) When the project has adequate right-of-way, vehicles, materials, and equipment shall be located a minimum of 30 ft (9 m) from the pavement.

(b) When adequate right-of-way does not exist, vehicles, materials, and equipment shall be located a minimum of 15 ft (4.5 m) from the edge of any pavement open to traffic.

(c) Behind temporary concrete barrier, vehicles, materials, and equipment shall be located a minimum of 24 in. (600 mm) behind free standing barrier or a minimum of 6 in. (150 mm) behind barrier that is either pinned or restrained according to Article 704.04. The 24 in. or 6 in. measurement shall be from the base of the non-traffic side of the barrier.

(d) Behind other man-made or natural barriers meeting the approval of the Engineer."

**FUEL COST ADJUSTMENT (BDE)**
Effective: April 1, 2009 Revised: August 1, 2017

**Description**. Fuel cost adjustments will be made to provide additional compensation to the Contractor, or a credit to the Department, for fluctuations in fuel prices when optioned by the Contractor. The bidder shall indicate with their bid whether or not this special provision will be part of the contract. Failure to indicate "Yes" for any category of work will make that category of work exempt from fuel cost adjustment.

**General**. The fuel cost adjustment shall apply to contract pay items as grouped by category. The adjustment shall only apply to those categories of work checked "Yes", and only when the cumulative plan quantities for a category exceed the required threshold. Adjustments to work items in a category, either up or down, and extra work paid for by agreed unit price will be subject to fuel cost adjustment only when the category representing the added work was subject to the fuel cost adjustment. Extra work paid for at a lump sum price or by force account will not be subject to fuel cost adjustment. Category descriptions and thresholds for application and the fuel usage factors which are applicable to each are as follows:

(a) Categories of Work.

(1) Category A: Earthwork. Contract pay items performed under Sections 202, 204, and 206 including any modified standard or nonstandard items where the character of the work to be performed is considered earthwork. The cumulative total of all applicable item plan quantities shall exceed 25,000 cu yd (20,000 cu m). Included in the fuel usage factor is a weighted average 0.10 gal/cu yd (0.50 liters/cu m) factor for trucking.

(2) Category B: Subbases and Aggregate Base Courses. Contract pay items constructed under Sections 311, 312 and 351 including any modified standard or nonstandard items where the character of the work to be performed is considered construction of a subbase or aggregate, stabilized or modified base course. The cumulative total of all applicable item plan quantities shall exceed 5000 tons (4500 metric tons). Included in the fuel usage factor is a 0.60 gal/ton (2.50 liters/metric ton) factor for trucking.

(3) Category C: Hot-Mix Asphalt (HMA) Bases, Pavements and Shoulders. Contract pay items constructed under Sections 355, 406, 407 and 482 including any modified standard or nonstandard items where the character of the work to be performed is considered HMA bases, pavements and shoulders. The cumulative total of all applicable item plan quantities shall exceed 5000 tons (4500 metric tons). Included in the fuel usage factor is 0.60 gal/ton (2.50 liters/metric ton) factor for trucking.

(4) Category D: Portland Cement Concrete (PCC) Bases, Pavements and Shoulders. Contract pay items constructed under Sections 353, 420, 421 and 483 including any modified standard or nonstandard items where the character of the work to be performed is considered PCC base, pavement or shoulder. The cumulative total of all applicable item plan quantities shall exceed 7500 sq yd (6000 sq m). Included in the fuel usage factor is 1.20 gal/cu yd (5.94 liters/cu m) factor for trucking.

(5) Category E: Structures. Structure items having a cumulative bid price that exceeds $250,000 for pay items constructed under Sections 502, 503, 504, 505, 512, 516 and 540 including any modified standard or nonstandard items where the character of the work to be performed is considered structure work when similar to that performed under these sections and not included in categories A through D.

(b) Fuel Usage Factors.

English Units

| Category | Factor | Units |
|---|---|---|
| A - Earthwork | 0.34 | gal / cu yd |
| B – Subbase and Aggregate Base courses | 0.62 | gal / ton |
| C – HMA Bases, Pavements and Shoulders | 1.05 | gal / ton |
| D – PCC Bases, Pavements and Shoulders | 2.53 | gal / cu yd |
| E – Structures | 8.00 | gal / $1000 |

Metric Units

| Category | Factor | Units |
|---|---|---|
| A - Earthwork | 1.68 | liters / cu m |
| B – Subbase and Aggregate Base courses | 2.58 | liters / metric ton |
| C – HMA Bases, Pavements and Shoulders | 4.37 | liters / metric ton |
| D – PCC Bases, Pavements and Shoulders | 12.52 | liters / cu m |
| E – Structures | 30.28 | liters / $1000 |

(c) Quantity Conversion Factors.

| Category | Conversion | Factor |
|---|---|---|
| B | sq yd to ton | 0.057 ton / sq yd / in depth |
| | sq m to metric ton | 0.00243 metric ton / sq m / mm depth |
| C | sq yd to ton | 0.056 ton / sq yd / in depth |
| | sq m to metric ton | 0.00239 m ton / sq m / mm depth |
| D | sq yd to cu yd | 0.028 cu yd / sq yd / in depth |
| | sq m to cu m | 0.001 cu m / sq m / mm depth |

**Method of Adjustment**. Fuel cost adjustments will be computed as follows.

$CA = (FPI_P - FPI_L) \times FUF \times Q$

Where: CA = Cost Adjustment, $
$FPI_P$ = Fuel Price Index, as published by the Department for the month the work is performed, $/gal ($/liter)
$FPI_L$ = Fuel Price Index, as published by the Department for the month prior to the letting for work paid for at the contract price; or for the month the agreed unit price letter is submitted by the Contractor for extra work paid for by agreed unit price, $/gal ($/liter)
FUF = Fuel Usage Factor in the pay item(s) being adjusted
Q = Authorized construction Quantity, tons (metric tons) or cu yd (cu m)

The entire FUF indicated in paragraph (b) will be used regardless of use of trucking to perform the work.

**Basis of Payment**. Fuel cost adjustments may be positive or negative but will only be made when there is a difference between the $FPI_L$ and $FPI_P$ in excess of five percent, as calculated by:

Percent Difference = $\{(FPI_L - FPI_P) \div FPI_L\} \times 100$

Fuel cost adjustments will be calculated for each calendar month in which applicable work is performed; and will be paid or deducted when all other contract requirements for the items of work are satisfied. The adjustments shall not apply during contract time subject to liquidated damages for completion of the entire contract.

**GEOTECHNICAL FABRIC FOR PIPE UNDERDRAINS AND FRENCH DRAINS (BDE)**
Effective: November 1, 2019

Revise Article 1080.01(a) of the Standard Specifications to read:

" (a) Fabric Materials. Fabric materials shall be as follows.

(1) Knitted Fabric. Knitted fabric envelope shall be Type A according to ASTM D 6707 and be a continuous one piece knitted polymeric material that fits over the pipe underdrain like a sleeve. It shall be free from any chemical treatment or coating that might significantly reduce porosity and permittivity.

(2) Woven or Nonwoven Fabric. The fabric shall be Class 3 according to AASHTO M 288 and consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape like character) shall not be permitted. The yarns or filaments shall be dimensionally stable (i.e. maintain their relative position with respect to each other) and resistant to delamination. The yarns or filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permittivity.

(3) Physical Properties. The physical properties for knitted, woven, and nonwoven fabrics shall be according to the following.

| PHYSICAL PROPERTIES | | | |
|---|---|---|---|
| | Knitted 1/ | Woven 2/ | Nonwoven 2/ |
| Grab Strength, lb (N)<br>ASTM D 4632 3/ | -- | 180 (800) min. | 112 (500) min. |
| Elongation/Grab Strain, %<br>ASTM D 4632 3/ | -- | 49 max. | 50 min. |
| Trapezoidal Tear Strength, lb (N)<br>ASTM D 4533 3/ | -- | 67 (300) min. | 40 (180) min. |
| Puncture Strength, lb (N)<br>ASTM D 6241 3/ | 180 (800) min. | 370 (1650) min. | 222 (990) min. |
| Apparent Opening Size, Sieve No. (mm)<br>ASTM D 4751 4/ | 30 (0.60) max. | 40 (0.425) max. | 40 (0.425) max. |
| Permittivity, $sec^{-1}$<br>ASTM D 4491 | 1.0 min. | | |
| Ultraviolet Stability, % retained strength after 500 hours of exposure<br>ASTM D 4355 | -- | 50 min. | 50 min. |

1/ Manufacturer's certification to meet test requirements.

2/ NTPEP results or manufacturer’s certification to meet test requirements.

3/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

4/ Values represent the maximum average roll value.”

Revise Article 1080.05 of the Standard Specifications to read:

"**1080.05 Geotechnical Fabric for French Drains and Pipe Underdrains, Type 2.** Geotechnical fabric for french drains and pipe underdrains, Type 2 shall be Class 3 according to AASHTO M 288 and consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) shall not be permitted. The yarns or filaments shall be dimensionally stable (i.e. maintain their relative position with respect to each other) and resistant to delamination. The yarns or filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permittivity.

The fabric shall be according to the following.

| PHYSICAL PROPERTIES [1/] | | |
|---|---|---|
| | Woven | Nonwoven |
| Grab Strength, lb (N)<br>ASTM D 4632 [2/] | 180 (800) min. | 112 (500) min. |
| Elongation/Grab Strain, %<br>ASTM D 4632 [2/] | 49 max. | 50 min. |
| Trapezoidal Tear Strength, lb (N)<br>ASTM D 4533 [2/] | 67 (300) min. | 40 (180) min. |
| Puncture Strength, lb (N)<br>ASTM D 6241 [2/] | 370 (1650) min. | 222 (990) min. |
| Apparent Opening Size, Sieve No. (mm)<br>ASTM D 4751 [3/] | 60 (0.25) max. | |
| Permittivity, $sec^{-1}$<br>ASTM D 4491 | 0.2 min. | |
| Ultraviolet Stability % retained strength after 500 hours of exposure - ASTM D 4355 | 50 min. | |

1/ NTPEP results to meet test requirements. Manufacturer shall have public release status and current reports on laboratory results in Test Data of NTPEP's DataMine.

2/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

3/ Values represent the maximum average roll value."

**HOT-MIX ASPHALT – LONGITUDINAL JOINT SEALANT (BDE)**
Effective: August 1, 2018 Revised: November 1, 2019

Add the following to Article 406.02 of the Standard Specifications.

"(d) Longitudinal Joint Sealant (LJS) .....1032"

Add the following to Article 406.03 of the Standard Specifications.

"(k) Longitudinal Joint Sealant (LJS) Pressure Distributor (Note 2)
(l) Longitudinal Joint Sealant (LJS) Melter Kettle (Note 3)

Note 2. When a pressure distributor is used to apply the LJS, the distributor shall be equipped with a heating and recirculating system along with a functioning auger agitating system or vertical shaft mixer in the hauling tank to prevent localized overheating. The distributor shall be equipped with a guide or laser system to aid in proper placement of the LJS application.

Note 3. When a melter kettle is used to transport and apply the LJS, the melter kettle shall be an oil jacketed double-boiler with agitating and recirculating systems. Material from the kettle may be dispensed through a pressure feed wand with an applicator shoe or through a pressure feed wand into a hand-operated thermal push cart."

Revise Article 406.06(g)(2) of the Standard Specifications to read:

"(2) Longitudinal Joints. Unless prohibited by stage construction, any HMA lift shall be complete before construction of the subsequent lift. The longitudinal joint in all lifts shall be at the centerline of the pavement if the roadway comprises two lanes in width, or at lane width if the roadway is more than two lanes in width.

When stage construction prohibits the total completion of a particular lift, the longitudinal joint in one lift shall be offset from the longitudinal joint in the preceding lift by not less than 3 in. (75 mm). The longitudinal joint in the surface course shall be at the centerline of the pavement if the roadway comprises two lanes in width, or at lane width if the roadway is more than two lanes in width.

A notched wedge longitudinal joint shall be used between successive passes of HMA binder course that has a difference in elevation of greater than 2 in. (50 mm) between lanes on pavement that is open to traffic.

The notched wedge longitudinal joint shall consist of a 1 to 1 1/2 in. (25 to 38 mm) vertical notch at the lane line, a 9 to 12 in. (230 to 300 mm) wide uniform taper sloped toward and extending into the open lane, and a second 1 to 1 1/2 in. (25 to 38 mm) vertical notch at the outside edge.

The notched wedge longitudinal joint shall be formed by the strike off device on the paver. The wedge shall then be compacted by the joint roller.

Tack coat shall be applied to the entire surface of the notched wedge joint immediately prior to placing the adjacent lift of binder. The material shall be uniformly applied at a rate of 0.05 to 0.1 gal/sq yd (0.2 to 0.5 L/sq m).

When the use of longitudinal joint sealant (LJS) is specified, the surface to which the LJS is applied shall be thoroughly cleaned and dry. The LJS may be placed before or after the tack coat. When placed after the tack coat, the tack shall be fully cured prior to placement of the LJS.

The LJS shall be applied in a single pass with a pressure distributor, melter kettle, or hand applied from a roll. At the time of installation, the pavement surface temperature and the ambient temperature shall be a minimum of 40 °F (4 °C) and rising.

The LJS shall be applied at a width of 18 in. (450 mm) ± 1 1/2 in. (38 mm) and centered ± 2 in. (± 50 mm) under the joint of the next HMA lift to be constructed. If the LJS flows more than 2 in. (50 mm) from the initial placement width, LJS placement shall stop and remedial action shall be taken.

When starting another run of LJS placement, suitable release paper shall be placed over the previous application of LJS to prevent doubling up of thickness of LJS.

The application rate of LJS shall be according to the following.

| LJS Application Table | | | |
|---|---|---|---|
| Overlay Thickness in. (mm) | Coarse Graded Application Rate 1/ (IL-19.0, IL-19.0L, IL-9.5, IL-9.5L, IL-4.75) lb/ft (kg/m) | Fine Graded Application Rate 1/ lb/ft (kg/m) | SMA Mixtures 1/ 2/ |
| 3/4 (19) | 0.88 (1.31) | | |
| 1 (25) | 1.15 (1.71) | | |
| 1 1/4 (32) | 1.31 (1.95) | 0.88 (1.31) | |
| 1 1/2 (38) | 1.47 (2.19) | 0.95 (1.42) | 1.26 (1.88) |
| 1 3/4 (44) | 1.63 (2.43) | 1.03 (1.54) | 1.38 (2.06) |
| 2 (50) | 1.80 (2.68) | 1.11 (1.65) | 1.51 (2.25) |
| ≥ 2 1/4 (60) | 1.96 (2.92) | | |

1/ The application rate has a surface demand for liquid included within it. The thickness of the LJS may taper from the center of the application to a lesser thickness on the edge of the application, provided the correct width and application rate are maintained.

2/ If the joint is between SMA and either Coarse Graded or Fine Graded, the SMA rate shall be used.

The Contractor shall furnish to the Engineer a bill of lading for each tanker supplying material to the project. The application rate of LJS shall be verified within the first 1000 ft (300 m) of the day's placement and every 12,000 ft (3600 m) thereafter. A suitable paper or pan shall be placed at a random location in the path of the LJS. After application of the LJS, the paper or pan shall be picked up, weighed, and the application rate calculated. The tolerance between the application rate shown in the LJS Application Table and the calculated rate shall be ± 10 percent. The LJS shall be replaced in the area where the sample was taken.

A 1 qt (1 L) sample shall be taken from the pressure distributor or melting kettle at the jobsite once for each contract and sent to the Central Bureau of Materials.

The LJS shall be suitable for construction traffic to drive on without pickup or tracking of the LJS within 30 minutes of placement. If pickup or tracking occurs, LJS placement shall stop and damaged areas shall be repaired.

Prior to paving, the Contractor shall ensure the paver end plate and grade control device is adequately raised above the finished height of the LJS.

The LJS shall not flush to the final surface of the HMA pavement."

Add the following paragraph after the second paragraph of Article 406.13(b) of the Standard Specifications.

"Application of longitudinal joint sealant (LJS) will be measured for payment in place in feet (meters)."

Add the following paragraph after the first paragraph of Article 406.14 of the Standard Specifications.

"Longitudinal joint sealant will be paid for at the contract unit price per foot (meter) for LONGITUDINAL JOINT SEALANT."

Add the following to Section 1032 of the Standard Specifications.

"**1032.12 Longitudinal Joint Sealant (LJS).** Longitudinal joint sealant (LJS) will be accepted according to the current Bureau of Materials and Physical Research Policy Memorandum, "Performance Graded Asphalt Binder Acceptance Procedure" with the following exceptions: Article 3.1.9 and 3.4.1.4 of the policy memorandum will be excluded. The bituminous material used for the LJS shall be according to the following table. Elastomers shall be added to a base asphalt and shall be either a styrene-butadiene diblock or triblock copolymer without oil extension, or a styrene-butadiene rubber. Air blown asphalt, acid modification, or other modifiers will not be allowed. LJS in the form of pre-formed rollout banding may also be used.

| Test | Test Requirement | Test Method |
|---|---|---|
| Dynamic shear @ 88°C (unaged), G*/sin δ, kPa | 1.00 min. | AASHTO T 315 |
| Creep stiffness @ -18°C (unaged), Stiffness (S), MPa<br>m-value | 300 max.<br>0.300 min. | AASHTO T 313 |
| Ash, % | 1.0 – 4.0 | AASHTO T 111 |
| Elastic Recovery, 100 mm elongation, cut immediately, 25°C, % | 70 min. | ASTM D 6084 (Procedure A) |
| Separation of Polymer, Difference in °C of the softening point (ring and ball) | 3 max. | ITP Separation of Polymer from Asphalt Binder" |

**MANHOLES, VALVE VAULTS, AND FLAT SLAB TOPS (BDE)**
Effective: January 1, 2018 Revised: March 1, 2019

**Description.** In addition to those manufactured according to the current standards included in this contract, manholes, valve vaults, and flat slab tops manufactured prior to March 1, 2019, according to the previous Highway Standards listed below will be accepted on this contract:

| Product | Previous Standards | | |
|---|---|---|---|
| Precast Manhole Type A, 4' (1.22 m) Diameter | 602401-05 | 602401-04 | 602401-03 |
| Precast Manhole Type A, 5' (1.52 m) Diameter | 602402-01 | 602402 | 602401-03 |
| Precast Manhole Type A, 6' (1.83 m) Diameter | 602406-09 | 602406-08 | 602406-07 |
| Precast Manhole Type A, 7' (2.13 m) Diameter | 602411-07 | 602411-06 | 602411-05 |
| Precast Manhole Type A, 8' (2.44 m) Diameter | 602416-07 | 602416-06 | 602416-05 |
| Precast Manhole Type A, 9' (2.74 m) Diameter | 602421-07 | 602421-06 | 602421-05 |
| Precast Manhole Type A, 10' (3.05 m) Diameter | 602426-01 | 602426 | |
| Precast Valve Vault Type A, 4' (1.22 m) Diameter | 602501-04 | 602501-03 | 602501-02 |
| Precast Valve Vault Type A, 5' (1.52 m) Diameter | 602506-01 | 602506 | 602501-02 |
| Precast Reinforced Concrete Flat Slab Top | 602601-05 | 602601-04 | |

The following revisions to the Standard Specifications shall apply to manholes, valve vaults, and flat slab tops manufactured according to the current standards included in this contract:

Revise Article 602.02(g) of the Standard Specifications to read:

"(g) Structural Steel (Note 4) ..... 1006.04

Note 4. All components of the manhole joint splice shall be galvanized according to the requirements of AASHTO M 111 or M 232 as applicable."

Add the following to Article 602.02 of the Standard Specifications:

"(s) Anchor Bolts and Rods (Note 5) ..... 1006.09

Note 5. The threaded rods for the manhole joint splice shall be according to the requirements of ASTM F 1554, Grade 55, (Grade 380)."

Revise the second paragraph of Article 1042.10 of the Standard Specifications to read:

"Catch basin Types A, B, C, and D; Manhole Type A; Inlet Types A and B; Drainage Structures Types 1, 2, 3, 4, 5, and 6; Valve Vault Type A; and reinforced concrete flat slab top (Highway Standard 602601) shall be manufactured according to AASHTO M 199 (M 199M), except as shown on the plans. Additionally, catch basins, inlets, and drainage structures shall have a minimum concrete compressive strength of 4500 psi (31,000 kPa) at 28 days and manholes, valve vaults, and reinforced concrete flat slab tops shall have a minimum concrete compressive strength of 5000 psi (34,500 kPa) at 28 days."

**MOBILIZATION (BDE)**
Effective: April 1, 2020

Replace Articles 671.02(a), (b), and (c) of the Standard Specifications with the following:

"(a) Upon execution of the contract, 90 percent of the pay item will be paid.

(b) When 90 percent of the adjusted contract value is earned, the remaining ten percent of the pay item will be paid along with any amount bid in excess of six percent of the original contract amount."

**PAVEMENT MARKING REMOVAL (BDE)**
Effective: July 1, 2016

Revise Article 783.02 of the Standard Specifications to read:

"**783.02 Equipment.** Equipment shall be according to the following.

| Item | Article/Section |
|---|---|
| (a) Grinders (Note 1) | |
| (b) Water Blaster with Vacuum Recovery | 1101.12 |

Note 1. Grinding equipment shall be approved by the Engineer."

Revise the first paragraph of Article 783.03 of the Standard Specifications to read:

"**783.03 Removal of Conflicting Markings.** Existing pavement markings that conflict with revised traffic patterns shall be removed. If darkness or inclement weather prohibits the removal operations, such operations shall be resumed the next morning or when weather permits. In the event of removal equipment failure, such equipment shall be repaired, replaced, or leased so removal operations can be resumed within 24 hours."

Revise the first and second sentences of the first paragraph of Article 783.03(a) of the Standard Specifications to read:

"The existing pavement markings shall be removed by the method specified and in a manner that does not materially damage the surface or texture of the pavement or surfacing. Small particles of tightly adhering existing markings may remain in place, if in the opinion of the Engineer, complete removal of the small particles will result in pavement surface damage."

Revise the first paragraph of Article 783.04 of the Standard Specifications to read:

"**783.04 Cleaning.** The roadway surface shall be cleaned of debris or any other deleterious material by the use of compressed air or water blast."

Revise the first paragraph of Article 783.06 of the Standard Specifications to read:

"**783.06 Basis of Payment.** This work will be paid for at the contract unit price per each for RAISED REFLECTIVE PAVEMENT MARKER REMOVAL, or at the contract unit price per square foot (square meter) for PAVEMENT MARKING REMOVAL – GRINDING and/or PAVEMENT MARKING REMOVAL – WATER BLASTING."

Delete Article 1101.13 from the Standard Specifications.

**PORTLAND CEMENT CONCRETE (BDE)**
Effective: November 1, 2017

Revise the Air Content % of Class PP Concrete in Table 1 Classes of Concrete and Mix Design Criteria in Article 1020.04 of the Standard Specifications to read:

"TABLE 1. CLASSES OF CONCRETE AND MIX DESIGN CRITERIA

| Class of Conc. | Use | Air Content % |
|---|---|---|
| PP | Pavement Patching<br>Bridge Deck Patching (10) | |
| | PP-1 | 4.0 - 8.0" |
| | PP-2 | |
| | PP-3 | |
| | PP-4 | |
| | PP-5 | |

Revise Note (4) at the end of Table 1 Classes of Concrete and Mix Design Criteria in Article 1020.04 of the Standard Specifications to read:

"(4) For all classes of concrete, the maximum slump may be increased to 7 in (175 mm) when a high range water-reducing admixture is used. For Class SC, the maximum slump may be increased to 8 in. (200 mm). For Class PS, the maximum slump may be increased to 8 1/2 in. (215 mm) if the high range water-reducing admixture is the polycarboxylate type."

**PORTLAND CEMENT CONCRETE – HAUL TIME (BDE)**
Effective: July 1, 2020

Revise Article 1020.11(a)(7) of the Standard Specifications to read:

"(7) Haul Time. Haul time shall begin when the delivery ticket is stamped. The delivery ticket shall be stamped no later than five minutes after the addition of the mixing water to the cement, or after the addition of the cement to the aggregate when the combined aggregates contain free moisture in excess of two percent by weight (mass). If more than one batch is required for charging a truck using a stationary mixer, the time of haul shall start with mixing of the first batch. Haul time shall end when the truck is emptied for incorporation of the concrete into the work. The maximum haul time shall be as follows.

| Concrete Temperature at Point of Discharge, °F (°C) | Maximum Haul Time 1/ (minutes) | |
|---|---|---|
| | Truck Mixer or Truck Agitator | Nonagitator Truck |
| 50 - 64 (10 - 17.5) | 90 | 45 |
| > 64 (> 17.5) - without retarder | 60 | 30 |
| > 64 (> 17.5) - with retarder | 90 | 45 |

1/ To encourage start-up testing for mix adjustments at the plant, the first two trucks will be allowed an additional 15 minutes haul time whenever such testing is performed.

For a mixture which is not mixed on the jobsite, a delivery ticket shall be required for each load. The following information shall be recorded on each delivery ticket: (1) ticket number; (2) name of producer and plant location; (3) contract number; (4) name of Contractor; (5) stamped date and time batched; (6) truck number; (7) quantity batched; (8) amount of admixture(s) in the batch; (9) amount of water in the batch; and (10) Department mix design number.

For concrete mixed in jobsite stationary mixers, the above delivery ticket may be waived, but a method of verifying the haul time shall be established to the satisfaction of the Engineer."

**PORTLAND CEMENT CONCRETE PAVEMENT PLACEMENT (BDE)**
Effective: July 1, 2020

Revise the fifth paragraph of Article 420.07 of the Standard Specifications to read:

"The concrete shall be deposited uniformly across the subgrade or subbase as close as possible to its final position. The time elapsing from when the concrete is unloaded until it is incorporated into the work shall not exceed 20 minutes. When required, hand spreading shall be accomplished with shovels."

**RAILROAD PROTECTIVE LIABILITY INSURANCE (5 AND 10) (BDE)**
Effective: January 1, 2006

Description. Railroad Protective Liability and Property Damage Liability Insurance shall be carried according to Article 107.11 of the Standard Specifications, except the limits shall be a minimum of $5,000,000 combined single limit per occurrence for bodily injury liability and property damage liability with an aggregate limit of $10,000,000 over the life of the policy. A separate policy is required for each railroad unless otherwise noted.

| NAMED INSURED & ADDRESS | NUMBER & SPEED OF PASSENGER TRAINS | NUMBER & SPEED OF FREIGHT TRAINS |
|---|---|---|

DOT/AAR No.: RR Mile Post:
RR Division: RR Sub-Division:

For Freight/Passenger Information Contact: Phone:
For Insurance Information Contact: Phone:

DOT/AAR No.: RR Mile Post:
RR Division: RR Sub-Division:

For Freight/Passenger Information Contact: Phone:
For Insurance Information Contact: Phone:

Approval of Insurance. The original and one certified copy of each required policy shall be submitted to the following address for approval:

Illinois Department of Transportation
Bureau of Design and Environment
2300 South Dirksen Parkway, Room 326
Springfield, Illinois 62764

The Contractor will be advised when the Department has received approval of the insurance from the railroad(s). Before any work begins on railroad right-of-way, the Contractor shall submit to the Engineer evidence that the required insurance has been approved by the railroad(s). The Contractor shall also provide the Engineer with the expiration date of each required policy.

Basis of Payment. Providing Railroad Protective Liability and Property Damage Liability Insurance will be paid for at the contract unit price per Lump Sum for RAILROAD PROTECTIVE LIABILITY INSURANCE.

**REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES (BDE)**
Effective: January 1, 2019 Revised: January 1, 2020

Revise Section 669 of the Standard Specifications to read:

"**SECTION 669. REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES**

**669.01 Description.** This work shall consist of the transportation and proper disposal of regulated substances. This work shall also consist of the removal, transportation, and proper disposal of underground storage tanks (UST), their contents and associated underground piping to the point where the piping is above the ground, including determining the content types and estimated quantities.

**669.02 Equipment.** The Contractor shall notify the Engineer of the delivery of all excavation, storage, and transportation equipment to a work area location. The equipment shall comply with OSHA and American Petroleum Institute (API) guidelines and shall be furnished in a clean condition. Clean condition means the equipment does not contain any residual material classified as a non-special waste, non-hazardous special waste, or hazardous waste. Residual materials include, but are not limited to, petroleum products, chemical products, sludges, or any other material present in or on equipment.

Before beginning any associated soil or groundwater management activity, the Contractor shall provide the Engineer with the opportunity to visually inspect and approve the equipment. If the equipment contains any contaminated residual material, decontamination shall be performed on the equipment as appropriate to the regulated substance and degree of contamination present according to OSHA and API guidelines. All cleaning fluids used shall be treated as the contaminant unless laboratory testing proves otherwise.

**669.03 Pre-Construction Submittals and Qualifications.** Prior to beginning this work, or working in areas with regulated substances, the Contractor shall submit a "Regulated Substances Pre-Construction Plan (RSPCP)" to the Engineer for review and approval using form BDE 2730. The form shall be signed by an Illinois licensed Professional Engineer or Professional Geologist.

As part of the RSPCP, the Contractor(s) or firm(s) performing the work shall meet the following qualifications.

(a) Regulated Substances Monitoring. Qualification for environmental observation and field screening of regulated substances work and environmental observation of UST removal shall require either pre-qualification in Hazardous Waste by the Department or demonstration of acceptable project experience in remediation and operations for contaminated sites in accordance with applicable Federal, State, or local regulatory requirements using BDE 2730.

Qualification for each individual performing regulated substances monitoring shall require a minimum of one-year of experience in similar activities as those required for the project.

(b) Underground Storage Tank Removal. Qualification for underground storage tank (UST) removal work shall require licensing and certification with the Office of the State Fire Marshall (OSFM) and possession of all permits required to perform the work. A copy of the permit shall be provided to the Engineer prior to tank removal.

The qualified Contractor(s) or firm(s) shall also document it does not have any current or former ties with any of the properties contained within, adjoining, or potentially affecting the work.

The Engineer will require up to 21 calendar days for review of the RSPCP. The review may involve rejection or revision and resubmittal; in which case, an additional 21 days will be required for each subsequent review. Work shall not commence until the RSPCP has been approved by the Engineer. After approval, the RSPCP shall be revised as necessary to reflect changed conditions in the field and documented using BDE 2730A “Regulated Substances Pre-Construction Plan (RSPCP) Addendum” and submitted to the Engineer for approval.

## CONSTRUCTION REQUIREMENTS

**669.04 Regulated Substances Monitoring.** Regulated substances monitoring includes environmental observation and field screening during regulated substances management activities at the contract specific work areas. As part of the regulated substances monitoring, the monitoring personnel shall perform and document the applicable duties listed on form BDE 2732 “Regulated Substances Monitoring Daily Record (RSMDR)”.

(a) Environmental Observation. Prior to beginning excavation, the Contractor shall mark the limits of the contract specific work areas. Once work begins, the monitoring personnel shall be present on-site continuously during the excavation and loading of material.

(b) Field Screening. Field screening shall be performed during the excavation and loading of material from the contract specific work areas, except for material classified according to Article 669.05(b)(1) or 669.05(c) where field screening is not required.

Field screening shall be performed with either a photoionization detector (PID) (minimum 10.6eV lamp) or a flame ionization detector (FID), and other equipment as appropriate, to monitor for potential contaminants associated with regulated substances. The PID or FID shall be calibrated on-site, and background level readings taken and recorded daily, and as field and weather conditions change. Field screen readings on the PID or FID in excess of background levels indicates the potential presence of regulated substances requiring handling as a non-special waste, special waste, or hazardous waste. PID or FID readings may be used as the basis of increasing the limits of removal with the approval of the Engineer but shall in no case be used to decrease the limits.

**669.05 Regulated Substances Management and Disposal.** The management and disposal of soil and/or groundwater containing regulated substances shall be according to the following:

(a) Soil Analytical Results Exceed Most Stringent MAC. When the soil analytical results indicate detected levels exceed the most stringent maximum allowable concentration (MAC) for chemical constituents in soil established pursuant to Subpart F of 35 Ill. Adm. Code 1100.605, the soil shall be managed as follows:

(1) When analytical results indicate inorganic chemical constituents exceed the most stringent MAC, but still considered within area background levels by the Engineer, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable. If the soils cannot be utilized within the right-of-way, they shall be managed and disposed of at a landfill as a non-special waste.

(2) When analytical results indicate inorganic chemical constituents exceed the most stringent MAC but do not exceed the MAC for a Metropolitan Statistical Area (MSA) County identified in 35 Ill. Admin. Code 742 Appendix A. Table G, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of at a clean construction and demolition debris (CCDD) facility or an uncontaminated soil fill operation (USFO) within an MSA County provided the pH of the soil is within the range of 6.25 - 9.0, inclusive.

(3) When analytical results indicate chemical constituents exceed the most stringent MAC but do not exceed the MAC for an MSA County excluding Chicago, or the MAC within the Chicago corporate limits, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of off-site at a CCDD facility or an USFO within an MSA County excluding Chicago or within the Chicago corporate limits provided the pH of the soil is within the range of 6.25 - 9.0, inclusive.

(4) When analytical results indicate chemical constituents exceed the most stringent MAC but do not exceed the MAC for an MSA County excluding Chicago, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of off-site at a CCDD facility or an USFO within an MSA County excluding Chicago provided the pH of the soil is within the range of 6.25 - 9.0, inclusive.

(5) When the Engineer determines soil cannot be managed according to Articles 669.05(a)(1) through (a)(4) above and the materials do not contain special waste or hazardous waste, as determined by the Engineer, the soil shall be managed and disposed of at a landfill as a non-special waste.

(6) When analytical results indicate soil is hazardous by characteristic or listing pursuant to 35 Ill. Admin. Code 721, contains radiological constituents, or the Engineer otherwise determines the soil cannot be managed according to Articles 669.05(a)(1) through (a)(5) above, the soil shall be managed and disposed of off-site as a special waste or hazardous waste as applicable.

(b) Soil Analytical Results Do Not Exceed Most Stringent MAC. When the soil analytical results indicate that detected levels do not exceed the most stringent MAC, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of off-site according to Article 202.03. However, the excavated soil cannot be taken to a CCDD facility or an USFO for any of the following reasons.

(1) The pH of the soil is less than 6.25 or greater than 9.0.

(2) The soil exhibited PID or FID readings in excess of background levels.

(c) Soil Analytical Results Exceed Most Stringent MAC but Do Not Exceed Tiered Approach to Corrective Action Objectives (TACO) Residential. When the soil analytical results indicate that detected levels exceed the most stringent MAC but do not exceed TACO Tier 1 Soil Remediation Objectives for Residential Properties pursuant to 35 Ill. Admin. Code 742 Appendix B Table A, the excavated soil can be utilized within the right-of-way as embankment or fill, when suitable, or managed and disposed of off-site according to Article 202.03. However, the excavated soil cannot be taken to a CCDD facility or an USFO.

(d) Groundwater. When groundwater analytical results indicate the detected levels are above Appendix B, Table E of 35 Ill. Admin. Code 742, the most stringent Tier 1 Groundwater Remediation Objectives for Groundwater Component of the Groundwater Ingestion Route for Class 1 groundwater, the groundwater shall be managed off-site as a special waste or hazardous waste as applicable. Special waste groundwater shall be containerized and trucked to an off-site treatment facility, or may be discharged to a sanitary sewer or combined sewer when permitted by the local sewer authority. Groundwater discharged to a sanitary sewer or combined sewer shall be pre-treated to remove particulates and measured with a calibrated flow meter to comply with applicable discharge limits. A copy of the permit shall be provided to the Engineer prior to discharging groundwater to the sanitary sewer or combined sewer.

Groundwater encountered within trenches may be managed within the trench and allowed to infiltrate back into the ground. If the groundwater cannot be managed within the trench, it may be discharged to a sanitary sewer or combined sewer when permitted by the local sewer authority, or it shall be containerized and trucked to an off-site treatment facility as a special waste or hazardous waste. The Contractor is prohibited from discharging groundwater within the trench through a storm sewer. The Contractor shall install backfill plugs within the area of groundwater contamination.

One backfill plug shall be placed down gradient to the area of groundwater contamination. Backfill plugs shall be installed at intervals not to exceed 50 ft (15 m). Backfill plugs are to be 4 ft (1.2 m) long, measured parallel to the trench, full trench width and depth. Backfill plugs shall not have any fine aggregate bedding or backfill, but shall be entirely cohesive soil or any class of concrete. The Contractor shall provide test data that the material has a permeability of less than $10^{-7}$ cm/sec according to ASTM D 5084, Method A or per another test method approved by the Engineer.

The Contractor shall use due care when transferring contaminated material from the area of origin to the transporter. Should releases of contaminated material to the environment occur (i.e., spillage onto the ground, etc.), the Contractor shall clean-up spilled material and place in the appropriate storage containers as previously specified. Clean-up shall include, but not be limited to, sampling beneath the material staging area to determine complete removal of the spilled material.

The Contractor shall provide engineered barriers, when required, and shall include materials sufficient to completely line excavation surfaces, including sloped surfaces, bottoms, and sidewall faces, within the areas designated for protection.

The Contractor shall obtain all documentation including any permits and/or licenses required to transport the material containing regulated substances to the disposal facility. The Contractor shall coordinate with the Engineer on the completion of all documentation. The Contractor shall make all arrangements for collection and analysis of landfill acceptance testing. The Contractor shall coordinate waste disposal approvals with the disposal facility.

The Contractor shall provide the Engineer with all transport-related documentation within two days of transport or receipt of said document(s). For management of special or hazardous waste, the Contractor shall provide the Engineer with documentation that the Contractor is operating with a valid Illinois special waste transporter permit at least two weeks before transporting the first load of contaminated material.

Transportation and disposal of material classified according to Article 669.05(a)(5) or 669.05(a)(6) shall be completed each day so that none of the material remains on-site by the close of business, except when temporary staging has been approved.

Any waste generated as a special or hazardous waste from a non-fixed facility shall be manifested off-site using the Department's county generator number provided by the Bureau of Design and Environment. An authorized representative of the Department shall sign all manifests for the disposal of the contaminated material and confirm the Contractor's transported volume. Any waste generated as a non-special waste may be managed off-site without a manifest, a special waste transporter, or a generator number.

The Contractor shall select a landfill permitted for disposal of the contaminant within the State of Illinois. The Department will review and approve or reject the facility proposed by the Contractor to use as a landfill. The Contractor shall verify whether the selected disposal facility is compliant with those applicable standards as mandated by their permit and whether the disposal facility is presently, has previously been, or has never been, on the United States Environmental Protection Agency (U.S. EPA) National Priorities List or the Resource Conservation and Recovery Act (RCRA) List of Violating Facilities. The use of a Contractor selected landfill shall in no manner delay the construction schedule or alter the Contractor's responsibilities as set forth.

**669.06 Non-Special Waste Certification.** An authorized representative of the Department shall sign and date all non-special waste certifications. The Contractor shall be responsible for providing the Engineer with the required information that will allow the Engineer to certify the waste is not a special waste.

(a) Definition. A waste is considered a non-special waste as long as it is not:

(1) a potentially infectious medical waste;

(2) a hazardous waste as defined in 35 Ill. Admin. Code 721;

(3) an industrial process waste or pollution control waste that contains liquids, as determined using the paint filter test set forth in subdivision (3)(A) of subsection (m) of 35 Ill. Admin. Code 811.107;

(4) a regulated asbestos-containing waste material, as defined under the National Emission Standards for Hazardous Air Pollutants in 40 CFR Part 61.141;

(5) a material containing polychlorinated biphenyls (PCB's) regulated pursuant to 40 CFR Part 761;

(6) a material subject to the waste analysis and recordkeeping requirements of 35 Ill. Admin. Code 728.107 under land disposal restrictions of 35 Ill. Admin. Code 728;

(7) a waste material generated by processing recyclable metals by shredding and required to be managed as a special waste under Section 22.29 of the Environmental Protection Act; or

(8) an empty portable device or container in which a special or hazardous waste has been stored, transported, treated, disposed of, or otherwise handled.

(b) Certification Information. All information used to determine the waste is not a special waste shall be attached to the certification. The information shall include but not be limited to:

(1) the means by which the generator has determined the waste is not a hazardous waste;

(2) the means by which the generator has determined the waste is not a liquid;

(3) if the waste undergoes testing, the analytic results obtained from testing, signed and dated by the person responsible for completing the analysis;

(4) if the waste does not undergo testing, an explanation as to why no testing is needed;

(5) a description of the process generating the waste; and

(6) relevant material safety data sheets.

**669.07 Temporary Staging.** Soil classified according to Articles 669.05(a)(2), (b)(1), or (c) may be temporarily staged at the Contractor's option. Soil classified according to Articles 669.05(a)(1), (a)(3), (a)(4), (a)(5), (a)(6), or (b)(2) shall be managed and disposed of without temporary staging to the greatest extent practicable. If circumstances beyond the Contractor's control require temporary staging of these latter materials, the Contractor shall request approval from the Engineer in writing.

Temporary staging shall be accomplished within the right-of-way and the Contractor's means and methods shall be described in the approved or amended RSPCP. Staging areas shall not be located within 200 feet (61 m) of a public or private water supply well; nor within 100 feet (30 m) of sensitive environmental receptor areas, including wetlands, rivers, streams, lakes, or designated habitat zones.

The method of staging shall consist of containerization or stockpiling as applicable for the type, classification, and physical state (i.e., liquid, solid, semisolid) of the material. Materials of different classifications shall be staged separately with no mixing or co-mingling.

When containers are used, the containers and their contents shall remain intact and inaccessible to unauthorized persons until the manner of disposal is determined. The Contractor shall be responsible for all activities associated with the storage containers including, but not limited to, the procurement, transport, and labeling of the containers. The Contractor shall not use a storage container if visual inspection of the container reveals the presence of free liquids or other substances that could cause the waste to be reclassified as a hazardous or special waste.

When stockpiles are used, they shall be covered with a minimum 20-mil plastic sheeting or tarps secured using weights or tie-downs. Perimeter berms or diversionary trenches shall be provided to contain and collect for disposal any water that drains from the soil. Stockpiles shall be managed to prevent or reduce potential dust generation.

When staging non-special waste, special waste, or hazardous waste, the following additional requirements shall apply:

(a) Non-Special Waste. When stockpiling soil classified according to Article 669.05(a)(1) or 669.05(a)(5), an impermeable surface barrier between the materials and the ground surface shall be installed. The impermeable barrier shall consist of a minimum 20-mil plastic liner material and the surface of the stockpile area shall be clean and free of debris prior to placement of the liner. Measures shall also be taken to limit or discourage access to the staging area.

(b) Special Waste and Hazardous Waste. Soil classified according to Article 669.05(a)(6) shall not be stockpiled but shall be containerized immediately upon generation in containers, tanks or containment buildings as defined by RCRA, Toxic Substances Control Act (TSCA), and other applicable State or local regulations and requirements, including 35 Ill. Admin. Code Part 722, Standards Applicable to Generators of Hazardous Waste.

The staging area(s) shall be enclosed (by a fence or other structure) to restrict direct access to the area, and all required regulatory identification signs applicable to a staging area containing special waste or hazardous waste shall be deployed.

Storage containers shall be placed on an all-weather gravel-packed, asphalt, or concrete surface. Containers shall be in good condition and free of leaks, large dents, or severe rusting, which may compromise containment integrity. Containers must be constructed of, or lined with, materials that will not react or be otherwise incompatible with the hazardous or special waste contents. Containers used to store liquids shall not be filled more than 80 percent of the rated capacity. Incompatible wastes shall not be placed in the same container or comingled.

All containers shall be legibly labeled and marked using pre-printed labels and permanent marker in accordance with applicable regulations, clearly showing the date of waste generation, location and/or area of waste generation, and type of waste. The Contractor shall place these identifying markings on an exterior side surface of the container.

Storage containers shall be kept closed, and storage pads covered, except when access is needed by authorized personnel.

Special waste and hazardous waste shall be transported and disposed within 90 days from the date of generation.

**669.08 Underground Storage Tank Removal.** For the purposes of this section, an underground storage tank (UST) includes the underground storage tank, piping, electrical controls, pump island, vent pipes and appurtenances.

Prior to removing an UST, the Engineer shall determine whether the Department is considered an "owner" or "operator" of the UST as defined by the UST regulations (41 Ill. Adm. Code Part 176). Ownership of the UST refers to the Department's owning title to the UST during storage, use or dispensing of regulated substances. The Department may be considered an "operator" of the UST if it has control of, or has responsibility for, the daily operation of the UST. The Department may however voluntarily undertake actions to remove an UST from the ground without being deemed an "operator" of the UST.

In the event the Department is deemed not to be the "owner" or "operator" of the UST, the OSFM removal permit shall reflect who was the past "owner" or "operator" of the UST. If the "owner" or "operator" cannot be determined from past UST registration documents from OSFM, then the OSFM removal permit will state the "owner" or "operator" of the UST is the Department. The Department's Office of Chief Counsel (OCC) will review all UST removal permits prior to submitting any removal permit to the OSFM. If the Department is not the "owner" or "operator" of the UST then it will not register the UST or pay any registration fee.

The Contractor shall be responsible for obtaining permits required for removing the UST, notification to the OSFM, using an OSFM certified tank contractor, removal and disposal of the UST and its contents, and preparation and submittal of the OSFM Site Assessment Report in accordance with 41 Ill. Admin. Code Part 176.330.

The Contractor shall contact the Engineer and the OSFM's office at least 72 hours prior to removal to confirm the OSFM inspector's presence during the UST removal. Removal, transport, and disposal of the UST shall be according to the applicable portions of the latest revision of the "American Petroleum Institute (API) Recommended Practice 1604".

The Contractor shall collect and analyze tank content (sludge) for disposal purposes. The Contractor shall remove as much of the regulated substance from the UST system as necessary to prevent further release into the environment. All contents within the tank shall be removed, transported and disposed of, or recycled. The tank shall be removed and rendered empty according to IEPA definition.

The Contractor shall collect soil samples from the bottom and sidewalls of the excavated area in accordance with 35 Ill. Admin. Code Part 734.210(h) after the required backfill has been removed during the initial response action, to determine the level of contamination remaining in the ground, regardless if a release is confirmed or not by the OSFM on-site inspector.

In the event the UST is designated a leaking underground storage tank (LUST) by the OSFM's inspector, or confirmation by analytical results, the Contractor shall notify the Engineer and the District Environmental Studies Unit (DESU). Upon confirmation of a release of contaminants and notifications to the Engineer and DESU, the Contractor shall report the release to the Illinois Emergency Management Agency (IEMA) (e.g., by telephone or electronic mail) and provide them with whatever information is available ("owner" or "operator" shall be stated as the past registered "owner" or "operator", or the IDOT District in which the tank is located and the DESU Manager).

The Contractor shall perform the following initial response actions if a release is indicated by the OSFM inspector:

(a) Take immediate action to prevent any further release of the regulated substance to the environment, which may include removing, at the Engineer's discretion, and disposing of up to 4 ft (1.2 m) of the contaminated material, as measured from the outside dimension of the tank;

(b) Identify and mitigate fire, explosion and vapor hazards;

(c) Visually inspect any above ground releases or exposed below ground releases and prevent further migration of the released substance into surrounding soils and groundwater; and

(d) Continue to monitor and mitigate any additional fire and safety hazards posed by vapors and free product that have migrated from the tank excavation zone and entered into subsurface structures (such as sewers or basements).

The tank excavation shall be backfilled according to applicable portions of Sections 205, 208, and 550 with a material that will compact and develop stability. All uncontaminated concrete and soil removed during tank extraction may be used to backfill the excavation, at the discretion of the Engineer.

After backfilling the excavation, the site shall be graded and cleaned.

**669.09 Regulated Substances Final Construction Report.** Not later than 90 days after completing this work, the Contractor shall submit a "Regulated Substances Final Construction Report (RSFCR)" to the Engineer using form BDE 2733 and required attachments. The form shall be signed by an Illinois licensed Professional Engineer or Professional Geologist.

**669.10 Method of Measurement.** Non-special waste, special waste, and hazardous waste soil will be measured for payment according to Article 202.07(b) when performing earth excavation, Article 502.12(b) when excavating for structures, or by computing the volume of the trench using the maximum trench width permitted and the actual depth of the trench.

Groundwater containerized and transported off-site for management, storage, and disposal will be measured for payment in gallons (liters).

Backfill plugs will be measured in cubic yards (cubic meters) in place, except the quantity for which payment will be made shall not exceed the volume of the trench, as computed by using the maximum width of trench permitted by the Specifications and the actual depth of the trench, with a deduction for the volume of the pipe.

Engineered Barriers will be measured for payment in square yards (square meters).

**669.11 Basis of Payment.** The work of preparing, submitting and administering a Regulated Substances Pre-Construction Plan will be paid for at the contract lump sum price for REGULATED SUBSTANCES PRE-CONSTRUCTION PLAN.

Regulated substances monitoring, including completion of form BDE 2732 for each day of work, will be paid for at the contract unit price per calendar day, or fraction thereof to the nearest 0.5 calendar day, for REGULATED SUBSTANCES MONITORING.

The installation of engineered barriers will be paid for at the contract unit price per square yard (square meter) for ENGINEERED BARRIER.

The work of UST removal, soil excavation, soil and content sampling, the management of excavated soil and UST content, and UST disposal, will be paid for at the contract unit price per each for UNDERGROUND STORAGE TANK REMOVAL.

The transportation and disposal of soil and other materials from an excavation determined to be contaminated will be paid for at the contract unit price per cubic yard (cubic meter) for NON-SPECIAL WASTE DISPOSAL, SPECIAL WASTE DISPOSAL, or HAZARDOUS WASTE DISPOSAL.

The transportation and disposal of groundwater from an excavation determined to be contaminated will be paid for at the contract unit price per gallon (liter) for SPECIAL WASTE GROUNDWATER DISPOSAL or HAZARDOUS WASTE GROUNDWATER DISPOSAL. When groundwater is discharged to a sanitary or combined sewer by permit, the cost will be paid for according to Article 109.05.

Backfill plugs will be paid for at the contract unit price per cubic yard (cubic meter) for BACKFILL PLUGS.

Payment for temporary staging of soil classified according to Articles 669.05(a)(1), (a)(3), (a)(4), (a)(5), (a)(6), or (b)(2) will be paid for according to Article 109.04. The Department will not be responsible for any additional costs incurred, if mismanagement of the staging area, storage containers, or their contents by the Contractor results in excess cost expenditure for disposal or other material management requirements.

Payment for accumulated stormwater removal and disposal will be according to Article 109.04. Payment will only be allowed if appropriate stormwater and erosion control methods were used.

Payment for decontamination, labor, material, and equipment for monitoring areas beyond the specified areas, with the Engineer's prior written approval, will be according to Article 109.04.

When the waste material for disposal requires sampling for landfill disposal acceptance, the samples shall be analyzed for TCLP VOCs, SVOCs, RCRA metals, pH, ignitability, and paint filter test. The analysis will be paid for at the contract unit price per each for SOIL DISPOSAL ANALYSIS using EPA Methods 1311 (extraction), 8260B for VOCs, 8270C for SVOCs, 6010B and 7470A for RCRA metals, 9045C for pH, 1030 for ignitability, and 9095A for paint filter.

The work of preparing, submitting and administering a Regulated Substances Final Construction Report will be paid for at the contract lump sum price REGULATED SUBSTANCES FINAL CONSTRUCTION REPORT."

**SILT FENCE, INLET FILTERS, GROUND STABILIZATION AND RIPRAP FILTER FABRIC (BDE)**

Effective: November 1, 2019 Revised: April 1, 2020

Revise Article 280.02(m) and add Article 280.02(n) so the Standard Specifications read:

" (m) Above Grade Inlet Filter (Fitted) 1081.15(j)
(n) Above Grade Inlet Filter (Non-Fitted) 1081.15(k)"

Revise the last sentence of the first paragraph in Article 280.04(c) of the Standard Specifications to read:

" The protection shall be constructed with hay or straw bales, silt filter fence, above grade inlet filters (fitted and non-fitted), or inlet filters.

Revise the first sentence of the second paragraph in Article 280.04(c) of the Standard Specifications to read:

" When above grade inlet filters (fitted and non-fitted) are specified, they shall be of sufficient size to completely span and enclose the inlet structure."

Revise Article 1080.02 of the Standard Specifications to read:

"**1080.02 Geotextile Fabric.** The fabric for silt filter fence shall consist of woven fabric meeting the requirements of AASHTO M 288 for unsupported silt fence.

The fabric for ground stabilization shall consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven fabrics shall be Class 2 and nonwoven fabrics shall be Class 1 according to AASHTO M 288.

The physical properties for silt fence and ground stabilization fabrics shall be according to the following.

| PHYSICAL PROPERTIES | | | |
|---|---|---|---|
| | Silt Fence Woven 1/ | Ground Stabilization Woven 2/ | Ground Stabilization Nonwoven 2/ |
| Grab Strength, lb (N) 3/ ASTM D 4632 | 123 (550) MD 101 (450) XD | 247 (1100) min. 4/ | 202 (900) min. 4/ |
| Elongation/Grab Strain, % ASTM D 4632 4/ | 49 max. | 49 max. | 50 min. |
| Trapezoidal Tear Strength, lb (N) ASTM D 4533 4/ | -- | 90 (400) min. | 79 (350) min. |
| Puncture Strength, lb (N) ASTM D 6241 4/ | -- | 494 (2200) min. | 433 (1925) min. |
| Apparent Opening Size, Sieve No. (mm) ASTM D 4751 5/ | 30 (0.60) max. | 40 (0.43) max. | 40 (0.43) max. |
| Permittivity, $sec^{-1}$ ASTM D 4491 | 0.05 min. | | |
| Ultraviolet Stability, % retained strength after 500 hours of exposure ASTM D 4355 | 70 min. | 50 min. | 50 min. |

1/ NTPEP results or manufacturer's certification to meet test requirements.

2/ NTPEP results to meet test requirements. Manufacturer shall have public release status and current reports on laboratory results in Test Data of NTPEP's DataMine.

3/ MD = Machine direction. XD = Cross-machine direction.

4/ Values represent the minimum average roll value (MARV) in the weaker principle direction, MD or XD.

5/ Values represent the maximum average roll value."

Revise Article 1080.03 of the Standard Specifications to read:

"**1080.03 Filter Fabric.** The filter fabric shall consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven fabrics shall be Class 3 for riprap gradations RR 4 and RR 5, and Class 2 for RR 6 and RR 7 according to AASHTO M 288. Woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) shall not be permitted. Nonwoven fabrics shall be Class 2 for riprap gradations RR 4 and RR 5, and Class 1 for RR 6 and RR 7 according to AASHTO M 288. After forming, the fabric shall be processed so that the yarns or filaments retain their relative positions with respect to each other. The fabric shall be new and undamaged.

The filter fabric shall be manufactured in widths of not less than 6 ft (2 m). Sheets of fabric may be sewn together with thread of a material meeting the chemical requirements given for the yarns or filaments to form fabric widths as required. The sheets of filter fabric shall be sewn together at the point of manufacture or another approved location.

The filter fabric shall be according to the following.

| PHYSICAL PROPERTIES [1/] | | | | |
|---|---|---|---|---|
| | Gradation Nos. RR 4 & RR 5 | | Gradation Nos. RR 6 & RR 7 | |
| | Woven | Nonwoven | Woven | Nonwoven |
| Grab Strength, lb (N) ASTM D 4632 [2/] | 180 (800) min. | 157 (700) min. | 247 (1100) min. | 202 (900) min. |
| Elongation/Grab Strain, % ASTM D 4632 [2/] | 49 max. | 50 min. | 49 max. | 50 min. |
| Trapezoidal Tear Strength, lb (N) ASTM D 4533 [2/] | 67 (300) min. | 56 (250) min. | 90 (400) min. | 79 (350) min. |
| Puncture Strength, lb (N) ASTM D 6241 [2/] | 370 (1650) min. | 309 (1375) min. | 494 (2200) min. | 433 (1925) min. |
| Ultraviolet Stability, % retained strength after 500 hours of exposure - ASTM D 4355 | 50 min. | | | |

1/ NTPEP results to meet test requirements. Manufacturer shall have public release status and current reports on laboratory results in Test Data of NTPEP's DataMine.

2/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

As determined by the Engineer, the filter fabric shall meet the requirements noted in the following after an onsite investigation of the soil to be protected.

| Soil by Weight (Mass) Passing the No. 200 sieve (75 µm), % | Apparent Opening Size, Sieve No. (mm) - ASTM D 4751 [1/] | Permittivity, $sec^{-1}$ ASTM D 4491 |
|---|---|---|
| 49 max. | 60 (0.25) max. | 0.2 min. |
| 50 min. | 70 (0.22) max. | 0.1 min. |

1/ Values represent the maximum average roll value."

Revise Article 1081.15(h)(3)a of the Standard Specifications to read:

"a. Inner Filter Fabric Bag. The inner filter fabric bag shall be constructed of woven yarns or nonwoven filaments made of polyolefins or polyesters with a minimum silt and debris capacity of 2.0 cu ft (0.06 cu m). Woven fabric shall be Class 3 and nonwoven fabric shall be Class 2 according to AASHTO M 288. The fabric bag shall be according to the following.

| PHYSICAL PROPERTIES | | |
|---|---|---|
| | Woven | Nonwoven |
| Grab Strength, lb (N)<br>ASTM D 4632 1/ | 180 (800) min. | 157 (700) min. |
| Elongation/Grab Strain, %<br>ASTM D 4632 1/ | 49 max. | 50 min. |
| Trapezoidal Tear Strength, lb (N)<br>ASTM D 4533 1/ | 67 (300) min. | 56 (250) min. |
| Puncture Strength, lb (N)<br>ASTM D 6241 1/ | 370 (1650) min. | 309 (1375) min. |
| Apparent Opening Size, Sieve No. (mm)<br>ASTM D 4751 2/ | 60 (0.25) max. | |
| Permittivity, $sec^{-1}$<br>ASTM D 4491 | 2.0 min. | |
| Ultraviolet Stability, % retained strength after 500 hours of exposure – ASTM D 4355 | 70 min. | |

1/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

2/ Values represent the maximum average roll value."

Revise Article 1081.15(i)(1) of the Standard Specifications to read:

"(i) Urethane Foam/Geotextile. Urethane foam/geotextile shall be triangular shaped having a minimum height of 10 in. (250 mm) in the center with equal sides and a minimum 20 in. (500 mm) base. The triangular shaped inner material shall be a low density urethane foam. The outer geotextile fabric cover shall consist of woven yarns or nonwoven filaments made of polyolefins or polyesters placed around the inner material and shall extend beyond both sides of the triangle a minimum of 18 in. (450 mm). Woven filter fabric shall be Class 3 and nonwoven filter fabric shall be Class 2 according to AASHTO M 288.

(1) The geotextile shall meet the following properties.

| PHYSICAL PROPERTIES | | |
|---|---|---|
| | Woven | Nonwoven |
| Grab Strength, lb (N)<br>ASTM D 4632 1/ | 180 (800) min. | 157 (700) min. |
| Elongation/Grab Strain, %<br>ASTM D 4632 1/ | 49 max. | 50 min. |
| Trapezoidal Tear Strength, lb (N)<br>ASTM D 4533 1/ | 67 (300) min. | 56 (250) min. |
| Puncture Strength, lb (N)<br>ASTM D 6241 1/ | 370 (1650) min. | 309 (1375) min. |
| Apparent Opening Size, Sieve No. (mm)<br>ASTM D 4751 2/ | 30 (0.60) max. | |
| Permittivity, $sec^{-1}$<br>ASTM D 4491 | 2.0 min. | |
| Ultraviolet Stability, % retained strength after 500 hours of exposure – ASTM D 4355 | 70 min. | |

1/ Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].

2/ Values represent the maximum average roll value."

Add the following to Article 1081.15(i) of the Standard Specifications.

"(3) Certification. The manufacturer shall furnish a certificate with each shipment of urethane foam/geotex assemblies stating the amount of product furnished and that the material complies with th requirements."

Revise the title and first sentence of Article 1081.15(j) of the Standards Specifications to read:

"(j) Above Grade Inlet Filters (Fitted). Above grade inlet filters (fitted) shall consist of a rigid polyethylene frame covered with a fitted geotextile filter fabric."

Revise Article 1081.15(j)(2) of the Standard Specifications to read:

(2) Fitted Geotextile Filter Fabric. The fitted geotextile filter fabric shall consist of woven yarns or nonwoven filaments made of polyolefins or polyesters. Woven filter fabric shall be Class 3 and nonwoven filter fabric shall be Class 2 according to AASHTO M 288. The filter shall be fabricated to provide a direct fit to the frame. The top of the filter shall integrate a coarse screen with a minimum apparent opening size of 1/2 in. (13 mm) to allow large volumes of water to pass through in the event of heavy flows. The filter shall have integrated anti-buoyancy pockets capable of holding a minimum of 3.0 cu ft (0.08 cu m) of stabilization material. Each filter shall have a label with the following information sewn to or otherwise permanently adhered to the outside: manufacturer's name, product name, and lot, model, or serial number. The fitted geotextile filter fabric shall be according to the table in Article 1081.15(h)(3)a above."

Add Article 1081.15(k) to the Standard Specifications to read:

"(k) Above Grade Inlet Filters (Non-Fitted). Above grade inlet filters (non-fitted) shall consist of a geotextile fabric surrounding a metal frame. The frame shall consist of either a) a circular cage formed of welded wire mesh, or b) a collapsible aluminum frame, as described below.

(1) Frame Construction.

a) Welded Wire Mesh Frame. The frame shall consist of 6 in. x 6 in. (150 mm x 150 mm) welded wire mesh formed of #10 gauge (3.42 mm) steel conforming to ASTM A 185. The mesh shall be 30 in. (750 mm) tall and formed into a 42 in. (1.05 m) minimum diameter cylinder.

b) Collapsible Aluminum Frame. The collapsible aluminum frame shall consist of grade 6036 aluminum. The frame shall have anchor lugs that attach it to the inlet grate, which shall resist movement from water and debris. The collapsible joints of the frame shall have a locking device to secure the vertical members in place, which shall prevent the frame from collapsing while under load from water and debris.

(2) Geotextile Fabric. The geotextile fabric shall consist of woven yarns or nonwoven filaments made of polyolefins or polyesters. The woven filter fabric shall be a Class 3 and the nonwoven filter fabric shall be a Class 2 according to AASHTO M 288. The geotextile fabric shall be according to the table in Article 1081.15(h)(3)a above.

(3) Geotechnical Fabric Attachment to the Frame.

a) Welded Wire Mesh Frame. The woven or nonwoven geotextile fabric shall be wrapped 3 in. (75 mm) over the top member of a 6 in. x 6 in. (150 mm x 150 mm) welded wire mesh frame and secured with fastening rings constructed of wire conforming to ASTM A 641, A 809, A 370, and A 938 at 6 in. (150 mm) on center. The fastening rings shall penetrate both layers of geotextile and securely close around the steel mesh. The geotextile shall be secured to the sides of the welded wire mesh with fastening rings at a spacing of 1 per sq ft (11 per sq m) and securely close around a steel member.

b) Collapsible Aluminum Frame. The woven or nonwoven fabric shall be secured to the aluminum frame along the top and bottom of the frame perimeter with strips of aluminum secured to the perimeter member, such that the anchoring system provides a uniformly distributed stress throughout the geotechnical fabric.

(2) (4) Certification. The manufacturer shall furnish a certificate with each shipment of above grade inlet filter assemblies stating the amount of product furnished and that the material complies with these requirements."

**STEEL COST ADJUSTMENT (BDE)**
Effective: April 2, 2004 Revised: August 1, 2017

**Description**. Steel cost adjustments will be made to provide additional compensation to the Contractor, or a credit to the Department, for fluctuations in steel prices when optioned by the Contractor. The bidder shall indicate with their bid whether or not this special provision will be part of the contract. Failure to indicate "Yes" for any item of work will make that item of steel exempt from steel cost adjustment.

**Types of Steel Products**. An adjustment will be made for fluctuations in the cost of steel used in the manufacture of the following items:

Metal Piling (excluding temporary sheet piling)
Structural Steel
Reinforcing Steel

Other steel materials such as dowel bars, tie bars, mesh reinforcement, guardrail, steel traffic signal and light poles, towers and mast arms, metal railings (excluding wire fence), and frames and grates will be subject to a steel cost adjustment when the pay items they are used in have a contract value of $10,000 or greater.

The adjustments shall apply to the above items when they are part of the original proposed construction, or added as extra work and paid for by agreed unit prices. The adjustments shall not apply when the item is added as extra work and paid for at a lump sum price or by force account.

**Documentation**. Sufficient documentation shall be furnished to the Engineer to verify the following:

(a) The dates and quantity of steel, in lb (kg), shipped from the mill to the fabricator.

(b) The quantity of steel, in lb (kg), incorporated into the various items of work covered by this special provision. The Department reserves the right to verify submitted quantities.

**Method of Adjustment**. Steel cost adjustments will be computed as follows:

SCA = Q X D

Where: SCA = steel cost adjustment, in dollars
Q = quantity of steel incorporated into the work, in lb (kg)
D = price factor, in dollars per lb (kg)

$D = MPI_M - MPI_L$

Where: $MPI_M$ = The Materials Cost Index for steel as published by the Engineering News-Record for the month the steel is shipped from the mill. The indices will be converted from dollars per 100 lb to dollars per lb (kg).

$MPI_L$ = The Materials Cost Index for steel as published by the Engineering News-Record for the month prior to the letting for work paid for at the contract price; or for the month the agreed unit price letter is submitted by the Contractor for extra work paid for by agreed unit price,. The indices will be converted from dollars per 100 lb to dollars per lb (kg).

The unit weights (masses) of steel that will be used to calculate the steel cost adjustment for the various items are shown in the attached table.

No steel cost adjustment will be made for any products manufactured from steel having a mill shipping date prior to the letting date.

If the Contractor fails to provide the required documentation, the method of adjustment will be calculated as described above; however, the $MPI_M$ will be based on the date the steel arrives at the job site. In this case, an adjustment will only be made when there is a decrease in steel costs.

**Basis of Payment**. Steel cost adjustments may be positive or negative but will only be made when there is a difference between the $MPI_L$ and $MPI_M$ in excess of five percent, as calculated by:

$$\text{Percent Difference} = \{(MPI_L - MPI_M) \div MPI_L\} \times 100$$

Steel cost adjustments will be calculated by the Engineer and will be paid or deducted when all other contract requirements for the items of work are satisfied. Adjustments will only be made for fluctuations in the cost of the steel as described herein. No adjustment will be made for changes in the cost of manufacturing, fabrication, shipping, storage, etc.

The adjustments shall not apply during contract time subject to liquidated damages for completion of the entire contract.

**Attachment**

| Item | Unit Mass (Weight) |
|---|---|
| Metal Piling (excluding temporary sheet piling) | |
| Furnishing Metal Pile Shells 12 in. (305 mm), 0.179 in. (3.80 mm) wall thickness) | 23 lb/ft (34 kg/m) |
| Furnishing Metal Pile Shells 12 in. (305 mm), 0.250 in. (6.35 mm) wall thickness) | 32 lb/ft (48 kg/m) |
| Furnishing Metal Pile Shells 14 in. (356 mm), 0.250 in. (6.35 mm) wall thickness) | 37 lb/ft (55 kg/m) |
| Other piling | See plans |
| Structural Steel | See plans for weights (masses) |
| Reinforcing Steel | See plans for weights (masses) |
| Dowel Bars and Tie Bars | 6 lb (3 kg) each |
| Mesh Reinforcement | 63 lb/100 sq ft (310 kg/sq m) |
| Guardrail | |
| Steel Plate Beam Guardrail, Type A w/steel posts | 20 lb/ft (30 kg/m) |
| Steel Plate Beam Guardrail, Type B w/steel posts | 30 lb/ft (45 kg/m) |
| Steel Plate Beam Guardrail, Types A and B w/wood posts | 8 lb/ft (12 kg/m) |
| Steel Plate Beam Guardrail, Type 2 | 305 lb (140 kg) each |
| Steel Plate Beam Guardrail, Type 6 | 1260 lb (570 kg) each |
| Traffic Barrier Terminal, Type 1 Special (Tangent) | 730 lb (330 kg) each |
| Traffic Barrier Terminal, Type 1 Special (Flared) | 410 lb (185 kg) each |
| Steel Traffic Signal and Light Poles, Towers and Mast Arms | |
| Traffic Signal Post | 11 lb/ft (16 kg/m) |
| Light Pole, Tenon Mount and Twin Mount, 30 - 40 ft (9 – 12 m) | 14 lb/ft (21 kg/m) |
| Light Pole, Tenon Mount and Twin Mount, 45 - 55 ft (13.5 – 16.5 m) | 21 lb/ft (31 kg/m) |
| Light Pole w/Mast Arm, 30 - 50 ft (9 – 15.2 m ) | 13 lb/ft (19 kg/m) |
| Light Pole w/Mast Arm, 55 - 60 ft (16.5 – 18 m) | 19 lb/ft (28 kg/m) |
| Light Tower w/Luminaire Mount, 80 - 110 ft (24 – 33.5 m) | 31 lb/ft (46 kg/m) |
| Light Tower w/Luminaire Mount, 120 - 140 ft (36.5 – 42.5 m) | 65 lb/ft (97 kg/m) |
| Light Tower w/Luminaire Mount, 150 - 160 ft (45.5 – 48.5 m) | 80 lb/ft (119 kg/m) |
| Metal Railings (excluding wire fence) | |
| Steel Railing, Type SM | 64 lb/ft (95 kg/m) |
| Steel Railing, Type S-1 | 39 lb/ft (58 kg/m) |
| Steel Railing, Type T-1 | 53 lb/ft (79 kg/m) |
| Steel Bridge Rail | 52 lb/ft (77 kg/m) |
| Frames and Grates | |
| Frame | 250 lb (115 kg) |
| Lids and Grates | 150 lb (70 kg) |

**SUBCONTRACTOR AND DBE PAYMENT REPORTING (BDE)**
Effective: April 2, 2018

Add the following to Section 109 of the Standard Specifications.

"**109.14 Subcontractor and Disadvantaged Business Enterprise Payment Reporting.** The Contractor shall report all payments made to the following parties:

(a) first tier subcontractors;

(b) lower tier subcontractors affecting disadvantaged business enterprise (DBE) goal credit;

(c) material suppliers or trucking firms that are part of the Contractor's submitted DBE utilization plan.

The report shall be made through the Department's on-line subcontractor payment reporting system within 21 days of making the payment."

**SUBCONTRACTOR MOBILIZATION PAYMENTS (BDE)**
Effective: November 2, 2017 Revised: April 1, 2019

Replace the second paragraph of Article 109.12 of the Standard Specifications with the following:

"This mobilization payment shall be made at least seven days prior to the subcontractor starting work. The amount paid shall be at the following percentage of the amount of the subcontract reported on form BC 260A submitted for the approval of the subcontractor's work.

| Value of Subcontract Reported on Form BC 260A | Mobilization Percentage |
|---|---|
| Less than $10,000 | 25% |
| $10,000 to less than $20,000 | 20% |
| $20,000 to less than $40,000 | 18% |
| $40,000 to less than $60,000 | 16% |
| $60,000 to less than $80,000 | 14% |
| $80,000 to less than $100,000 | 12% |
| $100,000 to less than $250,000 | 10% |
| $250,000 to less than $500,000 | 9% |
| $500,000 to $750,000 | 8% |
| Over $750,000 | 7%" |

**TEMPORARY PAVEMENT MARKING (BDE)**
Effective: April 1, 2012 Revised: April 1, 2017

Revise Article 703.02 of the Standard Specifications to read:

"**703.02 Materials.** Materials shall be according to the following.

(a) Pavement Marking Tape, Type I and Type III ..... 1095.06
(b) Paint Pavement Markings ..... 1095.02
(c) Pavement Marking Tape, Type IV ..... 1095.11"

Revise the second paragraph of Article 703.05 of the Standard Specifications to read:

"Type I marking tape or paint shall be used at the option of the Contractor, except paint shall not be applied to the final wearing surface unless authorized by the Engineer for late season applications where tape adhesion would be a problem. Type III or Type IV marking tape shall be used on the final wearing surface when the temporary pavement marking will conflict with the permanent pavement marking such as on tapers, crossovers and lane shifts."

Revise Article 703.07 of the Standard Specifications to read:

"**703.07 Basis of Payment.** This work will be paid for as follows.

a) Short Term Pavement Marking. Short term pavement marking will be paid for at the contract unit price per foot (meter) for SHORT TERM PAVEMENT MARKING. Removal of short term pavement markings will be paid for at the contract unit price per square foot (square meter) for SHORT TERM PAVEMENT MARKING REMOVAL.

b) Temporary Pavement Marking. Where the Contractor has the option of material type, temporary pavement marking will be paid for at the contract unit price per foot (meter) for TEMPORARY PAVEMENT MARKING of the line width specified, and at the contract unit price per square foot (square meter) for TEMPORARY PAVEMENT MARKING LETTERS AND SYMBOLS.

Where the Department specifies the use of pavement marking tape, the Type III or Type IV temporary pavement marking will be paid for at the contract unit price per foot (meter) for PAVEMENT MARKING TAPE, TYPE III or PAVEMENT MARKING TAPE, TYPE IV of the line width specified and at the contract unit price per square feet (square meter) for PAVEMENT MARKING TAPE, TYPE III - LETTERS AND SYMBOLS or PAVEMENT MARKING TAPE, TYPE IV – LETTERS AND SYMBOLS.

Removal of temporary pavement markings will be paid for at the contract unit price per square foot (square meter) for TEMPORARY PAVEMENT MARKING REMOVAL.

When temporary pavement marking is shown on the Standard, the cost of the temporary pavement marking and its removal will be included in the cost of the Standard."

Add the following to Section 1095 of the Standard Specifications:

"**1095.11 Pavement Marking Tape, Type IV.** The temporary, preformed, patterned markings shall consist of a white or yellow tape with wet retroreflective media incorporated to provide immediate and continuing retroreflection during both wet and dry conditions. The tape shall be manufactured without the use of heavy metals including lead chromate pigments or other similar, lead-containing chemicals.

The white and yellow Type IV marking tape shall meet the Type III requirements of Article 1095.06 and the following.

(a) Composition. The retroreflective pliant polymer pavement markings shall consist of a mixture of high-quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, with a layer of wet retroreflective media bonded to a durable polyurethane topcoat surface. The patterned surface shall have approximately 40% ± 10% of the surface area raised and presenting a near vertical face to traffic from any direction. The channels between the raised areas shall be substantially free of exposed beads or particles.

(b) Retroreflectance. The white and yellow markings shall meet the following for initial dry and wet retroreflectance.

(1) Dry Retroreflectance. Dry retroreflectance shall be measured under dry conditions according to ASTM D 4061 and meet the values described in Article 1095.06 for Type III tape.

(2) Wet Retroreflectance. Wet retroreflectance shall be measured under wet conditions according to ASTM E 2177 and meet the values shown in the following table.

**Wet Retroreflectance, Initial $R_L$**

| Color | $R_L$ 1.05/88.76 |
|---|---|
| White | 300 |
| Yellow | 200 |

(c) Color. The material shall meet the following requirements for daylight reflectance and color, when tested, using a color spectrophotometer with 45 degrees circumferential/zero degree geometry, illuminant D65, and a two degree observer angle. The color instrument shall measure the visible spectrum from 380 to 720 nm with a wavelength measurement interval and spectral bandpass of 10 nm.

| Color | Daylight Reflectance %Y |
|---|---|
| White | 65 minimum |
| *Yellow | 36-59 |

*Shall match Federal 595 Color No. 33538 and the chromaticity limits as follows.

| | | | | |
|---|---|---|---|---|
| x | 0.490 | 0.475 | 0.485 | 0.530 |
| y | 0.470 | 0.438 | 0.425 | 0.456 |

(d) Skid Resistance. The surface of the markings shall provide an average minimum skid resistance of 50 BPN when tested according to ASTM E 303.

(e) Sampling, Testing, Acceptance, and Certification. Prior to approval and use of the wet reflective, temporary, removable pavement marking tape, the manufacturer shall submit a notarized certification from an independent laboratory, together with the results of all tests, stating that the material meets the requirements as set forth herein. The certification test report shall state the lot tested, manufacturer's name, and date of manufacture.

After approval by the Department, samples and certification by the manufacturer shall be submitted for each batch used. The manufacturer shall submit a certification stating that the material meets the requirements as set forth herein and is essentially identical to the material sent for qualification. The certification shall state the lot tested, manufacturer's name, and date of manufacture.

All costs of testing (other than tests conducted by the Department) shall be borne by the manufacturer."

**TRAFFIC CONTROL DEVICES - CONES (BDE)**
Effective: January 1, 2019

Revise Article 701.15(a) of the Standard Specifications to read:

"(a) Cones. Cones are used to channelize traffic. Cones used to channelize traffic at night shall be reflectorized; however, cones shall not be used in nighttime lane closure tapers or nighttime lane shifts."

Revise Article 1106.02(b) of the Standard Specifications to read:

"(b) Cones. Cones shall be predominantly orange. Cones used at night that are 28 to 36 in. (700 to 900 mm) in height shall have two white circumferential stripes. If non-reflective spaces are left between the stripes, the spaces shall be no more than 2 in. (50mm) in width. Cones used at night that are taller than 36 in. (900 mm) shall have a minimum of two white and two fluorescent orange alternating, circumferential stripes with the top stripe being fluorescent orange. If non-reflective spaces are left between the stripes, the spaces shall be no more than 3 in. (75 mm) in width.

The minimum weights for the various cone heights shall be 4 lb for 18 in. (2 kg for 450 mm), 7 lb for 28 in. (3 kg for 700 mm), and 10 lb for 36 in. (5 kg for 900 mm) with a minimum of 60 percent of the total weight in the base. Cones taller than 36 in. shall be weighted per the manufacturer's specifications such that they are not moved by wind or passing traffic."

**TRAFFIC SPOTTERS (BDE)**
Effective: January 1, 2019

Revise Article 701.13 of the Standard Specifications to read:

"**701.13 Flaggers and Spotters.** Flaggers shall be certified by an agency approved by the Department. While on the job site, each flagger shall have in his/her possession a current driver's license and a current flagger certification I.D. card. For non-drivers, the Illinois Identification Card issued by the Secretary of State will meet the requirement for a current driver's license. This certification requirement may be waived by the Engineer for emergency situations that arise due to actions beyond the Contractor's control where flagging is needed to maintain safe traffic control on a temporary basis. Spotters are defined as certified flaggers that provide support to workers by monitoring traffic.

Flaggers and spotters shall be stationed to the satisfaction of the Engineer and be equipped with a fluorescent orange, fluorescent yellow/green, or a combination of fluorescent orange and fluorescent yellow/green vest meeting the requirements of ANSI/ISEA 107-2004 or ANSI/ISEA 107-2010 for Conspicuity Class 2 garments. Flaggers shall be equipped with a stop/slow traffic control sign. Spotters shall be equipped with a loud warning device. The warning sound shall be identifiable by workers so they can take evasive action when necessary. Other types of garments may be substituted for the vest as long as the garments have a manufacturer's tag identifying them as meeting the ANSI Class 2 requirement. The longitudinal placement of the flagger may be increased up to 100 ft (30 m) from that shown on the plans to improve the visibility of the flagger. Flaggers shall not encroach on the open lane of traffic unless traffic has been stopped. Spotters shall not encroach on the open lane of traffic, nor interact with or control the flow of traffic.

For nighttime flagging, flaggers shall be illuminated by an overhead light source providing a minimum vertical illuminance of 10 fc (108 lux) measured 1 ft (300 mm) out from the flagger's chest. The bottom of any luminaire shall be a minimum of 10 ft (3 m) above the pavement. Luminaire(s) shall be shielded to minimize glare to approaching traffic and trespass light to adjoining properties. Nighttime flaggers shall be equipped with fluorescent orange or fluorescent orange and fluorescent yellow/green apparel meeting the requirements of ANSI/ISEA 107-2004 or ANSI/ISEA 107-2010 for Conspicuity Class 3 garments.

Flaggers and spotters shall be provided per the traffic control plan and as follows.

(a) Two-Lane Highways. Two flaggers will be required for each separate operation where two-way traffic is maintained over one lane of pavement. Work operations controlled by flaggers shall be no more than 1 mile (1600 m) in length. Flaggers shall be in sight of each other or in direct communication at all times. Direct communication shall be obtained by using portable two-way radios or walkie-talkies.

    The Engineer will determine when a side road or entrance shall be closed to traffic. A flagger will be required at each side road or entrance remaining open to traffic within the operation where two-way traffic is maintained on one lane of pavement. The flagger shall be positioned as shown on the plans or as directed by the Engineer.

(b) Multi-Lane Highways. At all times where traffic is restricted to less than the normal number of lanes on a multilane pavement with a posted speed limit greater than 40 mph and the workers are present, but not separated from the traffic by physical barriers, a flagger or spotter shall be furnished as shown on the plans. Flaggers shall warn and direct traffic. Spotters shall monitor traffic conditions and warn workers of errant approaching vehicles or other hazardous conditions as they occur. One flagger will be required for each separate activity of an operation that requires frequent encroachment in a lane open to traffic. One spotter will be required for each separate activity with workers near the edge of the open lane or with their backs facing traffic.

Flaggers will not be required when no work is being performed, unless there is a lane closure on two-lane, two-way pavement."

**IDOT TRAINING PROGRAM GRADUATE ON-THE-JOB TRAINING SPECIAL PROVISION**
Effective: August 1, 2012 Revised: February 2, 2017

In addition to the Contractor's equal employment opportunity (EEO) affirmative action efforts undertaken as required by this Contract, the Contractor is encouraged to participate in the incentive program described below to provide additional on-the-job training to certified graduates of the IDOT pre-apprenticeship training program, as outlined in this Special Provision.

IDOT funds, and various Illinois community colleges operate, pre-apprenticeship training programs throughout the State to provide training and skill-improvement opportunities to promote the increased employment of minority groups, disadvantaged persons and women in all aspects of the highway construction industry. The intent of this IDOT Pre-Apprenticeship Training Program Graduate (TPG) special provision (Special Provision) is to place these certified program graduates on the project site for this Contract in order to provide the graduates with meaningful on-the-job training. Pursuant to this Special Provision, the Contractor must make every reasonable effort to recruit and employ certified TPG trainees to the extent such individuals are available within a practicable distance of the project site.

Specifically, participation of the Contractor or its subcontractor in the Program entitles the participant to reimbursement for graduates' hourly wages at $15.00 per hour per utilized TPG trainee, subject to the terms of this Special Provision. Reimbursement payment will be made even though the Contractor or subcontractor may also receive additional training program funds from other non-IDOT sources for other non-TPG trainees on the Contract, provided such other source does not specifically prohibit the Contractor or subcontractor from receiving reimbursement from another entity through another program, such as IDOT through the TPG program. With regard to any IDOT funded construction training program other than TPG, however, additional reimbursement for other IDOT programs will not be made beyond the TPG Program described in this Special Provision when the TPG Program is utilized.

No payment will be made to the Contractor if the Contractor or subcontractor fails to provide the required on-site training to TPG trainees, as solely determined by IDOT. A TPG trainee must begin training on the project as soon as the start of work that utilizes the relevant trade skill and the TPG trainee must remain on the project site through completion of the Contract, so long as training opportunities continue to exist in the relevant work classification. Should a TPG trainee's employment end in advance of the completion of the Contract, the Contractor must promptly notify the IDOT District EEO Officer for the Contract that the TPG's involvement in the Contract has ended. The Contractor must supply a written report for the reason the TPG trainee involvement terminated, the hours completed by the TPG trainee on the Contract, and the number of hours for which the incentive payment provided under this Special Provision will be, or has been claimed for the separated TPG trainee.

Finally, the Contractor must maintain all records it creates as a result of participation in the Program on the Contract, and furnish periodic written reports to the IDOT District EEO Officer that document its contractual performance under and compliance with this Special Provision. Finally, through participation in the Program and reimbursement of wages, the Contractor is not relieved of, and IDOT has not waived, the requirements of any federal or state labor or employment law applicable to TPG workers, including compliance with the Illinois Prevailing Wage Act.

**Method of Measurement**: The unit of measurement is in hours.

**Basis of Payment**: This work will be paid for at the contract unit price of $15.00 per hour for each utilized certified TPG Program trainee (TRAINEES TRAINING PROGRAM GRADUATE). The estimated total number of hours, unit price, and total price must be included in the schedule of prices for the Contract submitted by Contractor prior to beginning work. The initial number of TPG trainees for which the incentive is available for this contract is **7**.

The Department has contracted with several educational institutions to provide screening, tutoring and pre-training to individuals interested in working as a TPG trainee in various areas of common construction trade work. Only individuals who have successfully completed a Pre-Apprenticeship Training Program at these IDOT approved institutions are eligible to be TPG trainees. To obtain a list of institutions that can connect the Contractor with eligible TPG trainees, the Contractor may contact: HCCTP TPG Program Coordinator, Office of Business and Workforce Diversity (IDOT OBWD), Room 319, Illinois Department of Transportation, 2300 S. Dirksen Parkway, Springfield, Illinois 62764. Prior to commencing construction with the utilization of a TPG trainee, the Contractor must submit documentation to the IDOT District EEO Officer for the Contract that provides the names and contact information of the TPG trainee(s) to be trained in each selected work classification, proof that that the TPG trainee(s) has successfully completed a Pre-Apprenticeship Training Program, proof that the TPG is in an Apprenticeship Training Program approved by the U.S. Department of Labor Bureau of Apprenticeship Training, and the start date for training in each of the applicable work classifications.

To receive payment, the Contractor must provide training opportunities aimed at developing a full journeyworker in the type of trade or job classification involved. During the course of performance of the Contract, the Contractor may seek approval from the IDOT District EEO Officer to employ additional eligible TPG trainees. In the event the Contractor subcontracts a portion of the contracted work, it must determine how many, if any, of the TPGs will be trained by the subcontractor. Though a subcontractor may conduct training, the Contractor retains the responsibility for meeting all requirements imposed by this Special Provision. The Contractor must also include this Special Provision in any subcontract where payment for contracted work performed by a TPG trainee will be passed on to a subcontractor.

Training through the Program is intended to move TPGs toward journeyman status, which is the primary objective of this Special Provision. Accordingly, the Contractor must make every effort to enroll TPG trainees by recruitment through the Program participant educational institutions to the extent eligible TPGs are available within a reasonable geographic area of the project. The Contractor is responsible for demonstrating, through documentation, the recruitment efforts it has undertaken prior to the determination by IDOT whether the Contractor is in compliance with this Special Provision, and therefore, entitled to the Training Program Graduate reimbursement of $15.00 per hour.

Notwithstanding the on-the-job training requirement of this TPG Special Provision, some minimal off-site training is permissible as long as the offsite training is an integral part of the work of the contract, and does not compromise or conflict with the required on-site training that is central to the purpose of the Program. No individual may be employed as a TPG trainee in any work classification in which he/she has previously successfully completed a training program leading to journeyman status in any trade, or in which he/she has worked at a journeyman level or higher.

**WARM MIX ASPHALT (BDE)**
Effective: January 1, 2012 Revised: April 1, 2016

**Description**. This work shall consist of designing, producing and constructing Warm Mix Asphalt (WMA) in lieu of Hot Mix Asphalt (HMA) at the Contractor's option. Work shall be according to Sections 406, 407, 408, 1030, and 1102 of the Standard Specifications, except as modified herein. In addition, any references to HMA in the Standard Specifications, or the special provisions shall be construed to include WMA.

WMA is an asphalt mixture which can be produced at temperatures lower than allowed for HMA utilizing approved WMA technologies. WMA technologies are defined as the use of additives or processes which allow a reduction in the temperatures at which HMA mixes are produced and placed. WMA is produced by the use of additives, a water foaming process, or combination of both. Additives include minerals, chemicals or organics incorporated into the asphalt binder stream in a dedicated delivery system. The process of foaming injects water into the asphalt binder stream, just prior to incorporation of the asphalt binder with the aggregate.

Approved WMA technologies may also be used in HMA provided all the requirements specified herein, with the exception of temperature, are met. However, asphalt mixtures produced at temperatures in excess of 275 °F (135 °C) will not be considered WMA when determining the grade reduction of the virgin asphalt binder grade.

**Equipment**.

Revise the first paragraph of Article 1102.01 of the Standard Specifications to read:

"**1102.01 Hot-Mix Asphalt Plant.** The hot-mix asphalt (HMA) plant shall be the batch-type, continuous-type, or dryer drum plant. The plants shall be evaluated for prequalification rating and approval to produce HMA according to the current Bureau of Materials and Physical Research Policy Memorandum, "Approval of Hot-Mix Asphalt Plants and Equipment". Once approved, the Contractor shall notify the Bureau of Materials and Physical Research to obtain approval of all plant modifications. The plants shall not be used to produce mixtures concurrently for more than one project or for private work unless permission is granted in writing by the Engineer. The plant units shall be so designed, coordinated and operated that they will function properly and produce HMA having uniform temperatures and compositions within the tolerances specified. The plant units shall meet the following requirements."

Add the following to Article 1102.01(a) of the Standard Specifications.

"(11) Equipment for Warm Mix Technologies.

a. Foaming. Metering equipment for foamed asphalt shall have an accuracy of ± 2 percent of the actual water metered. The foaming control system shall be electronically interfaced with the asphalt binder meter.

b. Additives. Additives shall be introduced into the plant according to the supplier's recommendations and shall be approved by the Engineer. The system for introducing the WMA additive shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes."

**Mix Design Verification.**

Add the following to Article 1030.04 of the Standard Specifications.

"(e) Warm Mix Technologies.

(1) Foaming. WMA mix design verification will not be required when foaming technology is used alone (without WMA additives). However, the foaming technology shall only be used on HMA designs previously approved by the Department.

(2) Additives. WMA mix designs utilizing additives shall be submitted to the Engineer for mix design verification."

**Construction Requirements.**

Revise the second paragraph of Article 406.06(b)(1) of the Standard Specifications to read:

"The HMA shall be delivered at a temperature of 250 to 350 °F (120 to 175 °C). WMA shall be delivered at a minimum temperature of 215 °F (102 °C)."

**Basis of Payment.**

This work will be paid at the contract unit price bid for the HMA pay items involved. Anti-strip will not be paid for separately, but shall be considered as included in the cost of the work.

**WEEKLY DBE TRUCKING REPORTS (BDE)**
Effective: June 2, 2012 Revised: April 2, 2015

The Contractor shall submit a weekly report of Disadvantaged Business Enterprise (DBE) trucks hired by the Contractor or subcontractors (i.e. not owned by the Contractor or subcontractors) that are used for DBE goal credit.

The report shall be submitted to the Engineer on Department form “SBE 723” within ten business days following the reporting period. The reporting period shall be Monday through Sunday for each week reportable trucking activities occur.

Any costs associated with providing weekly DBE trucking reports shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed.

**PROJECT LABOR AGREEMENT**
Effective: May 18, 2007 Revised: August 1, 2019

**Description.** The Illinois Project Labor Agreements Act, 30 ILCS 571, states that the State of Illinois has a compelling interest in awarding public works contracts so as to ensure the highest standards of quality and efficiency at the lowest responsible cost. A project labor agreement (PLA) is a form of pre-hire collective bargaining agreement covering all terms and conditions of employment on a specific project that is intended to support this compelling interest. It has been determined by the Department that a PLA is appropriate for the project that is the subject of this contract. The PLA document, provided below, only applies to the construction site for this contract. It is the policy of the Department on this contract, and all construction projects, to allow all contractors and subcontractors to compete for contracts and subcontracts without regard to whether they are otherwise parties to collective bargaining agreements.

**Execution of Letter of Assent.** A copy of the PLA applicable to this project is included as part of this special provision. As a condition of the award of the contract, the successful bidder and each of its subcontractors shall execute a "Contractor Letter of Assent", in the form attached to the PLA as Exhibit A. The successful bidder shall submit a Subcontractor's Contractor Letter of Assent to the Department prior to the subcontractor's performance of work on the project. Upon request, copies of the applicable collective bargaining agreements will be provided by the appropriate signatory labor organization at the pre-job conference.

**Quarterly Reporting.** Section 37 of the Illinois Project Labor Agreements Act requires the Department to submit quarterly reports regarding the number of minorities and females employed under PLAs. To assist in this reporting effort, the Contractor shall provide a quarterly workforce participation report for all minority and female employees working under the PLA of this contract. The data shall be reported on Construction Form BC 820, Project Labor Agreement (PLA) Workforce Participation Quarterly Reporting Form available on the Department's website http://www.idot.illinois.gov/Assets/uploads/files/IDOT-Forms/BC/BC%20820.docx.

The report shall be submitted no later than the 15th of the month following the end of each quarter (i.e., April 15 for the January – March reporting period). The form shall be emailed to DOT.PLA.Reporting@illinois.gov or faxed to (217) 524-4922.

Any costs associated with complying with this provision shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed.

Illinois Department of Transportation
**PROJECT LABOR AGREEMENT**

This Project Labor Agreement ("PLA" or "Agreement") is entered into this_____ day of _____, 2019, by and between the Illinois Department of Transportation ("IDOT" or "Department") in its proprietary capacity, and each relevant Illinois AFL-CIO Building Trades signatory hereto as determined by the Illinois AFL-CIO Statewide Project Labor Agreement Committee on behalf of each of its affiliated members (individually and collectively, the "Unions"). This PLA shall apply to Construction Work (as defined herein) to be performed by IDOT's Prime Contractor and each of its subcontractors of whatever tier ("Subcontractor" or "Subcontractors") on Contract No. (hereinafter, the "Project").

## ARTICLE 1 - INTENT AND PURPOSES

1.1 This PLA is entered into in accordance with the Project Labor Agreement Act ("Act", 30 ILCS 571). It is mutually understood and agreed that the terms and conditions of this PLA are intended to promote the public interest in obtaining timely and economical completion of the Project by encouraging productive and efficient construction operations; by establishing a spirit of harmony and cooperation among the parties; and by providing for peaceful and prompt settlement of any and all labor grievances or jurisdictional disputes of any kind without strikes, lockouts, slowdowns, delays, or other disruptions to the prosecution of the work. The parties acknowledge the obligations of the Contractors and Subcontractors to comply with the provisions of the Act. The parties will work with the Contractors and Subcontractors within the parameters of other statutory and regulatory requirements to implement the Act's goals and objectives.

1.2 As a condition of the award of the contract for performance of work on the Project, IDOT's Prime Contractor and each of its Subcontractors shall execute a "Contractor Letter of Assent", in the form attached hereto as Exhibit A, prior to commencing Construction Work on the Project. The Contractor shall submit a Subcontractor's Contractor Letter of Assent to the Department prior to the Subcontractor's performance of Construction Work on the Project. Upon request copies of the applicable collective bargaining agreements will be provided by the appropriate signatory labor organization consistent with this Agreement and at the pre-job conference referenced in Article III, Section 3.1.

1.3 Each Union affiliate and separate local representing workers engaged in Construction Work on the Project in accordance with this PLA are bound to this agreement by the Illinois AFL-CIO Statewide Project Labor Agreement Committee which is the central committee established with full authority to negotiate and sign PLAs with the State on behalf of all respective crafts. Upon their signing the Contractor Letter of Assent, the Prime Contractor, each Subcontractor, and the individual Unions shall thereafter be deemed a party to this PLA. No party signatory to this PLA shall, contract or subcontract, nor permit any other person, firm, company, or entity to contract or subcontract for the performance of Construction Work for the Project to any person, firm, company, or entity that does not agree in writing to become bound for the term of this Project by the terms of this PLA prior to commencing such work and to the applicable area-wide collective bargaining agreement(s) with the Union(s) signatory hereto.

1.4 It is understood that the Prime Contractor(s) and each Subcontractor will be considered and accepted by the Unions as separate employers for the purposes of collective bargaining, and it is further agreed that the employees working under this PLA shall constitute a bargaining unit separate and distinct from all others. The parties hereto also agree that this PLA shall be applicable solely with respect to this Project, and shall have no bearing on the interpretation of any other collective bargaining agreement or as to the recognition of any bargaining unit other than for the specific purposes of this Project.

1.5 In the event of a variance or conflict, whether explicit or implicit, between the terms and conditions of this PLA and the provisions of any other applicable national, area, or local collective bargaining agreement, the terms and conditions of this PLA shall supersede and control. For any work performed under the NTL Articles of Agreement, the National Stack/Chimney Agreement, the National Cooling Tower Agreement, the National Agreement of the International Union of Elevator Constructors, and for any instrument calibration work and loop checking performed under the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, the preceding sentence shall apply only with respect to Articles I, II, V, VI, and VII.

1.6 Subject to the provisions of paragraph 1.5 of this Article, it is the parties' intent to respect the provisions of any other collective bargaining agreements that may now or hereafter pertain, whether between the Prime Contractor and one or more of the Unions or between a Subcontractor and one or more of the Unions. Accordingly, except and to the extent of any contrary provision set forth in this PLA, the Prime Contractor and each of its Subcontractors agrees to be bound and abide by the terms of the following in order of precedence: (a) the applicable collective bargaining agreement between the Prime Contractor and one or more of the Unions made signatory hereto; (b) the applicable collective bargaining agreement between a Subcontractor and one or more of the Unions made signatory hereto; or (c) the current applicable area collective bargaining agreement for the relevant Union that is the agreement certified by the Illinois Department of Labor for purposes of establishing the Prevailing Wage applicable to the Project. The Union will provide copies of the applicable collective bargaining agreements pursuant to part (c) of the preceding sentence to the Prime Contractor. Assignments by the Contractors or Subcontractors amongst the trades shall be consistent with area practices; in the event of unresolved disagreements as to the propriety of such assignments, the provisions of Article VI shall apply.

1.7 Subject to the limitations of paragraphs 1.4 to 1.6 of this Article, the terms of each applicable collective bargaining agreement as determined in accordance with paragraph 1.6 are incorporated herein by reference, and the terms of this PLA shall be deemed incorporated into such other applicable collective bargaining agreements only for purposes of their application to the Project.

1.8 To the extent necessary to comply with the requirements of any fringe benefit fund to which the Prime Contractor or Subcontractor is required to contribute under the terms of an applicable collective bargaining agreement pursuant to the preceding paragraph, the Prime Contractor or Subcontractor shall execute all "Participation Agreements" as may be reasonably required by the Union to accomplish such purpose; provided, however, that such Participation Agreements shall, when applicable to the Prime Contractor or Subcontractor solely as a result of this PLA, be amended as reasonably necessary to reflect such fact. Upon written notice in the form of a lien of a Contractor's or Subcontractor's delinquency from any applicable fringe benefit fund, IDOT will withhold from the Contractor's periodic pay request an amount sufficient to extinguish any delinquency obligation of the Contractor or Subcontractor arising out of the Project.

1.9 In the event that the applicable collective bargaining agreement between a Prime Contractor and the Union or between the Subcontractor and the Union expires prior to the completion of this Project, the expired applicable contract's terms will be maintained until a new applicable collective bargaining agreement is ratified. The wages and fringe benefits included in any new applicable collective bargaining agreement will apply on and after the effective date of the newly negotiated collective bargaining agreement, except to the extent wage and fringe benefit retroactivity is specifically agreed upon by the relevant bargaining parties.

## ARTICLE II – APPLICABILITY, RECOGNITION, AND COMMITMENTS

2.1 The term Construction Work as used herein shall include all “construction, demolition, rehabilitation, renovation, or repair” work performed by a “laborer or mechanic” at the “site of the work” for the purpose of “building” the specific structures and improvements that constitute the Project. Terms appearing within quotation marks in the preceding sentence shall have the meaning ascribed to them pursuant to 29 CFR Part 5 and Illinois labor laws.

2.2 By executing the Letters of Assent, Prime Contractor and each of its Subcontractors recognizes the Unions signatory to this PLA as the sole and exclusive bargaining representatives for their craft employees employed on the jobsite for this Project. Unions who are signatory to this PLA will have recognition on the Project for their craft.

2.3 The Prime Contractor and each of its Subcontractors retains and shall be permitted to exercise full and exclusive authority and responsibility for the management of its operations, except as expressly limited by the terms of this PLA or by the terms and conditions of the applicable collective bargaining agreement.

2.4 Except to the extent contrary to an express provision of the relevant collective bargaining agreement, equipment or materials used in the Project may be pre-assembled or pre- fabricated, and there shall be no refusal by the Union to handle, transport, install, or connect such equipment or materials. Equipment or materials delivered to the job-site will be unloaded and handled promptly without regard to potential jurisdictional disputes; any such disputes shall be handled in accordance with the provisions of this PLA.

2.5 The parties are mutually committed to promoting a safe working environment for all personnel at the job-site. It shall be the responsibility of each employer to which this PLA applies to provide and maintain safe working conditions for its employees, and to comply with all applicable federal, state, and local health and safety laws and regulations.

2.6 The use or furnishing of alcohol or drugs and the conduct of any other illegal activity at the job-site is strictly prohibited. The parties shall take every practical measure consistent with the terms of applicable collective bargaining agreements to ensure that the job-site is free of alcohol and drugs.

2.7 All parties to this PLA agree that they will not discriminate against any employee based on race, creed, religion, color, national origin, union activity, age, gender or sexual orientation and shall comply with all applicable federal, state, and local laws.

2.8 In accordance with the Act and to promote diversity in employment, IDOT will establish, in cooperation with the other parties, the apprenticeship hours which are to be performed by minorities and females on the Project. IDOT shall consider the total hours to be performed by these underrepresented groups, as a percentage of the workforce, and create aspirational goals for each Project, based on the level of underutilization for the service area of the Project (together "Project Employment Objectives"). IDOT shall provide a quarterly report regarding the racial and gender composition of the workforce on the Project.

Persons currently lacking qualifications to enter apprenticeship programs will have the opportunity to obtain skills through basic training programs as have been established by the Department. The parties will endeavor to support such training programs to allow participants to obtain the requisite qualifications for the Project Employment Objectives.

The parties agree that all Contractors and Subcontractors working on the Project shall be encouraged to utilize the maximum number of apprentices as permitted under the terms of the applicable collective bargaining agreements to realize the Project Employment Objectives.

The Unions shall assist the Contractor and each Subcontractor in efforts to satisfy Project Employment Objectives. A Contractor or Subcontractor may request from a Union specific categories of workers necessary to satisfy Project Employment Objectives. The application of this section shall be consistent with all local Union collective bargaining agreements, and the hiring hall rules and regulations established for the hiring of personnel, as well as the apprenticeship standards set forth by each individual Union.

2.9 The parties hereto agree that engineering consultants and materials testing employees, to the extent subject to the terms of this PLA, shall be fully expected to objectively and responsibly perform their duties and obligations owed to the Department without regard to the potential union affiliation of such employees or of other employees on the Project.

2.10 This Agreement shall not apply to IDOT employees or employees of any other governmental entity.

## ARTICLE III - ADMINISTRATION OF AGREEMENT

3.1 In order to assure that all parties have a clear understanding of the PLA, and to promote harmony, at the request of the Unions a post-award pre-job conference will be held among the Prime Contractor, all Subcontractors and Union representatives prior to the start of any Construction Work on the Project. No later than the conclusion of such pre-job conference, the parties shall, among other matters, provide to one another contact information for their respective representatives (including name, address, phone number, facsimile number, e-mail). Nothing herein shall be construed to limit the right of the Department to discuss or explain the purpose and intent of this PLA with prospective bidders or other interested parties prior to or following its award of the job.

3.2 Representatives of the Prime Contractor and the Unions shall meet as often as reasonably necessary following award until completion of the Project to assure the effective implementation of this PLA.

3.3 Any notice contemplated under Article VI and VII of this Agreement to a signatory labor organization shall be made in writing to the Local Union with copies to the local union's International Representative.

## ARTICLE IV - HOURS OF WORK AND GENERAL CONDITIONS

4.1 The standard work day and work week for Construction Work on the Project shall be consistent with the respective collective bargaining agreements. In the event Project site or other job conditions dictate a change in the established starting time and/or a staggered lunch period for portions of the Project or for specific crafts, the Prime Contractor, relevant Subcontractors and business managers of the specific crafts involved shall confer and mutually agree to such changes as appropriate. If proposed work schedule changes cannot be mutually agreed upon between the parties, the hours fixed at the time of the pre-job meeting shall prevail.

4.2 Shift work may be established and directed by the Prime Contractor or relevant Subcontractor as reasonably necessary or appropriate to fulfill the terms of its contract with the Department. If used, shift hours, rates and conditions shall be as provided in the applicable collective bargaining agreement.

4.3 The parties agree that chronic and/or unexcused absenteeism is undesirable and must be controlled in accordance with procedures established by the applicable collective bargaining agreement. Any employee disciplined for absenteeism in accordance with such procedures shall be suspended from all work on the Project for not less than the maximum period permitted under the applicable collective bargaining agreement.

4.4 Except as may be otherwise expressly provided by the applicable collective bargaining agreement, employment begins and ends at the Project site; employees shall be at their place of work at the starting time; and employees shall remain at their place of work until quitting time.

4.5 Except as may be otherwise expressly provided by the applicable collective bargaining agreement, there shall be no limit on production by workmen, no restrictions on the full use of tools or equipment, and no restrictions on efficient use of manpower ortechniques of construction other than as may be required by safety regulations.

4.6 The parties recognize that specialized or unusual equipment may be installed on the Project. In such cases, the Union recognizes the right of the Prime Contractor or Subcontractor to involve the equipment supplier or vendor's personnel in supervising the setting up of the equipment, making modifications and final alignment, and performing similar activities that may be reasonably necessary prior to and during the start-up procedure in order to protect factory warranties. The Prime Contractor or Subcontractor shall notify the Union representatives in advance of any work at the job-site by such vendor personnel in order to promote a harmonious relationship between the equipment vendor's personnel and other Project employees.

4.7 For the purpose of promoting full and effective implementation of this PLA, authorized Union representatives shall have access to the Project job-site during scheduled work hours. Such access shall be conditioned upon adherence to all reasonable visitor and security rules of general applicability that may be established for the Project site at the pre-job conference or from time to time thereafter.

## ARTICLE V – GRIEVANCE PROCEDURES FOR DISPUTES ARISING UNDER A PARTICULAR COLLECTIVE BARGAINING AGREEMENT

5.1 In the event a dispute arises under a particular collective bargaining agreement specifically not including jurisdictional disputes referenced in Article VI below, said dispute shall be resolved by the Grievance/Arbitration procedure of the applicable collective bargaining agreement. The resulting determination from this process shall be final and binding on all parties bound to its process.

5.2 Employers covered under this Agreement shall have the right to discharge or discipline any employee who violates the provisions of this Agreement. Such discharge or discipline by a contractor or subcontractor shall be subject to Grievance/Arbitration procedure of the applicable collective bargaining agreement only as to the fact of such violation of this agreement. If such fact is established, the penalty imposed shall not be disturbed. Work at the Project site shall continue without disruption or hindrance of any kind as a result of a Grievance/Arbitration procedure under this Article.

5.3 In the event there is a deadlock in the foregoing procedure, the parties agree that the matter shall be submitted to arbitration for the selection and decision of an Arbitrator governed under paragraph 6.8.

## ARTICLE VI –DISPUTES: GENERAL PRINCIPLES

6.1 This Agreement is entered into to prevent strikes, lost time, lockouts and to facilitate the peaceful adjustment of jurisdictional disputes in the building and construction industry and to prevent waste and unnecessary avoidable delays and expense, and for the further purpose of at all times securing for the employer sufficient skilled workers.

6.2 A panel of Permanent Arbitrators are attached as addendum (A) to this agreement. By mutual agreement between IDOT and the Unions, the parties can open this section of the agreement as needed to make changes to the list of permanent arbitrators.

The arbitrator is not authorized to award back pay or any other damages for a miss assignment of work. Nor may any party bring an independent action for back pay or any other damages, based upon a decision of an arbitrator.

6.3 The PLA Jurisdictional Dispute Resolution Process ("Process") sets forth the procedures below to resolve jurisdictional disputes between and among Contractors, Subcontractors, and Unions engaged in the building and construction industry. Further, the Process will be followed for any grievance or dispute arising out of the interpretation or application of this PLA by the parties except for the prohibition on attorneys contained in 6.11. All decisions made through the Process are final and binding upon all parties.

## DISPUTE PROCESS

6.4 Administrative functions under the Process shall be performed through the offices of the President and/or Secretary-Treasurer of the Illinois State Federation of Labor, or their designated representative, called the Administrator. In no event shall any officer, employee, agent, attorney, or other representative of the Illinois Federation of Labor, AFL- CIO be subject to any subpoena to appear or testify at any jurisdictional dispute hearing.

6.5 There shall be no abandonment of work during any case participating in this Process or in violation of the arbitration decision. All parties to this Process release the Illinois State Federation of Labor ("Federation") from any liability arising from its action or inaction and covenant not to sue the Federation, nor its officers, employees, agents or attorneys.

6.6 In the event of a dispute relating to trade or work jurisdiction, all parties, including the employers, Contractors or Subcontractors, agree that a final and binding resolution of the

dispute shall be resolved as follows:

(a) Representatives of the affected trades and the Contractor or Subcontractor shall meet on the job site within two (2) business days after receiving written notice in an effort to resolve the dispute. (In the event there is a dispute between local unions affiliated with the same International Union, the decision of the General President, or his/her designee, as the internal jurisdictional authority of that International Union, shall constitute a final and binding decision and determination as to the jurisdiction of work.)

(b) If no settlement is achieved subsequent to the preceding Paragraph, the matter shall be referred to the local area Building & Construction Trades Council, which shall meet with the affected trades within two (2) business days subsequent to receiving written notice. In the event the parties do not wish to avail themselves of the local Building & Construction Trades Council, the parties may elect to invoke the services of their respective International Representatives with no extension of the time limitations. An agreement reached at this Step shall be final and binding upon all parties.

(c) If no settlement agreement is reached during the proceedings contemplated by Paragraphs “a” or “b” above, the matter shall be immediately referred to the Illinois Jurisdictional Dispute Process for final and binding resolution of said dispute. Said referral submission shall be in writing and served upon the Illinois State Federation of Labor, or the Administrator, pursuant to paragraph 6.4 of this agreement. The Administrator shall, within three (3) days, provide for the selection of an available Arbitrator to hear said dispute within this time period. Upon good cause shown and determined by the Administrator, an additional three (3) day extension for said hearing shall be granted at the sole discretion of the Administrator. Only upon mutual agreement of all parties may the Administrator extend the hearing for a period in excess of the time frames contemplated under this Paragraph. Business days are defined as Monday through Friday, excluding contract holidays.

6.7 The primary concern of the Process shall be the adjustment of jurisdictional disputes arising out of the Project. A sufficient number of Arbitrators shall be selected from list of approved Arbitrators as referenced Sec. 6.2 and shall be assigned per Sec. 6.8. Decisions shall be only for the Project and shall become effective immediately upon issuance and complied with by all parties. The authority of the Arbitrator shall be restricted and limited specifically to the terms and provisions of Article VI and generally to this Agreement as a whole.

6.8 Arbitrator chosen shall be randomly selected based on the list of Arbitrators in Sec. 6.2 and geographical location of the jurisdictional dispute and upon his/her availability, and ability to conduct a Hearing within two (2) business days of said notice. The Arbitrator may issue a "bench" decision immediately following the Hearing or he/she may elect to only issue a written decision, said decision must be issued within two (2) business days subsequent to the completion of the Hearing. Copies of all notices, pleadings, supporting memoranda, decisions, etc. shall be provided to all disputing parties and the Illinois State Federation of Labor.

Any written decision shall be in accordance with this Process and shall be final and binding upon all parties to the dispute and may be a "short form" decision. Fees and costs of the arbitrator shall be divided evenly between the contesting parties except that any party wishing a full opinion and decision beyond the short form decision shall bear the reasonable fees and costs of such full opinion. The decision of the Arbitrator shall be final and binding upon the parties hereto, their members, and affiliates.

In cases of jurisdictional disputes or other disputes between a signatory labor organization and another labor organization, both of which is an affiliate or member of the same International Union, the matter or dispute shall be settled in the manner set forth by their International Constitution and/or as determined by the International Union's General President whose decision shall be final and binding upon all parties. In no event shall there be an abandonment of work.

6.9 In rendering a decision, the Arbitrator shall determine:

(a) First, whether a previous agreement of record or applicable agreement, including a disclaimer agreement, between National or International Unions to the dispute or agreements between local unions involved in the dispute, governs;

(b) Only if the Arbitrator finds that the dispute is not covered by an appropriate or applicable agreement of record or agreement between the crafts to the dispute, he shall then consider the established trade practice in the industry and prevailing practice in the locality. Where there is a previous decision of record governing the case, the Arbitrator shall give equal weight to such decision of record, unless the prevailing practice in the locality in the past ten years favors one craft. In that case, the Arbitrator shall base his decision on the prevailing practice in the locality. Except, that if the Arbitrator finds that a craft has improperly obtained the prevailing practice in the locality through raiding, the undercutting of wages or by the use of vertical agreements, the Arbitrator shall rely on the decision of record and established trade practice in the industry rather than the prevailing practice in the locality; and,

(c) Only if none of the above criteria is found to exist, the Arbitrator shall then consider that because efficiency, cost or continuity and good management are essential to the well being of the industry, the interests of the consumer or the past practices of the employer shall not be ignored.

(d) The arbitrator is not authorized to award back pay or any other damages for a mis-assignment of work. Nor may any party bring an independent action for back pay or any other damages, based upon a decision of an arbitrator.

6.10 The Arbitrator shall set forth the basis for his/her decision and shall explain his/her findings regarding the applicability of the above criteria. If lower ranked criteria are relied upon, the Arbitrator shall explain why the higher-ranked criteria were not deemed applicable. The Arbitrator's decision shall only apply to the Project. Agreements of Record, for other PLA projects, are applicable only to those parties signatory to such agreements. Decisions of Record are those that were either attested to by the former Impartial Jurisdictional Disputes Board or adopted by the National Arbitration Panel.

6.11 All interested parties, as determined by the Arbitrator, shall be entitled to make presentations to the Arbitrator. Any interested labor organization affiliated to the PLA Committee and party present at the Hearing, whether making a presentation or not, by such presence shall be deemed to accept the jurisdiction of the Arbitrator and to agree to be bound by its decision. In addition to the representative of the local labor organization, a representative of the labor organization's International Union may appear on behalf of the parties. Each party is responsible for arranging for its witnesses. In the event an Arbitrator's subpoena is required, the party requiring said subpoena shall prepare the subpoena for the Arbitrator to execute. Service of the subpoena upon any witness shall be the responsibility of the issuing party.

Attorneys shall not be permitted to attend or participate in any portion of a Hearing.

The parties are encouraged to determine, prior to Hearing, documentary evidence which may be presented to the Arbitrator on a joint basis.

6.12 The Order of Presentation in all Hearings before an Arbitrator shall be

I. Identification and Stipulation of the Parties
II. Unions(s) claiming the disputed work presents its case
III. Union(s) assigned the disputed work presents its case
IV. Employer assigning the disputed work presents its case
V. Evidence from other interested parties (i.e., general contractor, project manager, owner)
VI. Rebuttal by union(s) claiming the disputed work
VII. Additional submissions permitted and requested by Arbitrator VIII. Closing arguments by the parties

6.13 All parties bound to the provisions of this Process hereby release the Illinois State Federation of Labor and IDOT, their respective officers, agents, employees or designated representatives, specifically including any Arbitrator participating in said Process, from any and all liability or claim, of whatsoever nature, and specifically incorporating the protections provided in the Illinois Arbitration Act, as amended from time to time.

6.14 The Process, as an arbitration panel, nor its Administrator, shall have any authority to undertake any action to enforce its decision(s). Rather, it shall be the responsibility of the prevailing party to seek appropriate enforcement of a decision, including findings, orders or awards of the Arbitrator or Administrator determining non-compliance with a prior award or decision.

6.15 If at any time there is a question as to the jurisdiction of the Illinois Jurisdictional Dispute Resolution Process, the primary responsibility for any determination of the arbitrability of a dispute and the jurisdiction of the Arbitrator shall be borne by the party requesting the Arbitrator to hear the underlying jurisdictional dispute. The affected party or parties may proceed before the Arbitrator even in the absence or one or more stipulated parties with the issue of jurisdiction as an additional item to be decided by the Arbitrator. The Administrator may participate in proceedings seeking a declaration or determination that the underlying dispute is subject to the jurisdiction and process of the Illinois Jurisdictional Dispute Resolution Process. In any such proceedings, the non-prevailing party and/or the party challenging the jurisdiction of the Illinois Jurisdictional Dispute Resolution Process shall bear all the costs, expenses and attorneys' fees incurred by the Illinois Jurisdictional Dispute Resolution Process and/or its Administrator in establishing its jurisdiction.

## ARTICLE VII - WORK STOPPAGES AND LOCKOUTS

7.1 During the term of this PLA, no Union or any of its members, officers, stewards, employees, agents or representatives shall instigate, support, sanction, maintain, or participate in any strike, picketing, walkout, work stoppage, slow down or other activity that interferes with the routine and timely prosecution of work at the Project site or at any other contractor's or supplier's facility that is necessary to performance of work at the Project site. Hand billing at the Project site during the designated lunch period and before commencement or following conclusion of the established standard workday shall not, in itself, be deemed an activity that interferes with the routine and timely prosecution of work on the Project.

7.2 Should any activity prohibited by paragraph 7.1 of this Article occur, the Union shall undertake all steps reasonably necessary to promptly end such prohibited activities.

7.2.A No Union complying with its obligations under this Article shall be liable for acts of employees for which it has no responsibility or for the unauthorized acts of employees it represents. Any employee who participates or encourages any activity prohibited by paragraph 7.1 shall be immediately suspended from all work on the Project for a period equal to the greater of (a) 60 days; or (b) the maximum disciplinary period allowed under the applicable collective bargaining agreement for engaging in comparable unauthorized or prohibited activity.

7.2.B Neither the PLA Committee nor its affiliates shall be liable for acts of employees for which it has no responsibility. The principal officer or officers of the PLA Committee will immediately instruct, order and use the best efforts of his office to cause the affiliated union or unions to cease any violations of this Article. The PLA Committee in its compliance with this obligation shall not liable for acts of its affiliates. The principal officer or officers of any involved affiliate will immediately instruct, order or use the best effort of his office to cause the employees the union represents to cease any violations of this Article. A union complying with this obligation shall not be liable for unauthorized acts of employees it represents. The failure of the Contractor to exercise its rights in any instance shall not be deemed a waiver of its rights in any other instance.

During the term of this PLA, the Prime Contractor and its Subcontractors shall not engage in any lockout at the Project site of employees covered by this Agreement.

7.3 Upon notification of violations of this Article, the principal officer or officers of the local area Building and Construction Trades Council, and the Illinois AFL-CIO Statewide Project Labor Agreement Committee as appropriate, will immediately instruct, order and use their best efforts to cause the affiliated union or unions to cease any violations of this Article. A Trades Council and the Committee otherwise in compliance with the obligations under this paragraph shall not be liable for unauthorized acts of its affiliates.

7.4 In the event that activities in violation of this Article are not immediately halted through the efforts of the parties, any aggrieved party may invoke the special arbitration provisions set forth in paragraph 7.5 of this Article.

7.5 Upon written notice to the other involved parties by the most expeditious means available, any aggrieved party may institute the following special arbitration procedure when a breech of this Article is alleged:

7.5.A The party invoking this procedure shall notify the individual designated as the Permanent Arbitrator pursuant to paragraph 6.8 of the nature of the alleged violation; such notice shall be by the most expeditious means possible. The initiating party may also furnish such additional factual information as may be reasonably necessary for the Permanent Arbitrator to understand the relevant circumstances. Copies of any written materials provided to the arbitrator shall also be contemporaneously provided by the most expeditious means possible to the party alleged to be in violation and to all other involved parties.

7.5.B Upon receipt of said notice the Permanent Arbitrator shall set and hold a hearing within twenty-four (24) hours if it is contended the violation is ongoing, but not before twenty-four (24) hours after the written notice to all parties involved as required above.

7.5.C The Permanent Arbitrator shall notify the parties by facsimile or any other effective written means, of the place and time chosen by the Permanent Arbitrator for this hearing. Said hearing shall be completed in one session. A failure of any party or parties to attend said hearing shall not delay the hearing of evidence or issuance of an Award by the Permanent Arbitrator.

7.5.D The sole issue at the hearing shall be whether a violation of this Article has, in fact, occurred. An Award shall be issued in writing within three (3) hours after the close of the hearing, and may be issued without a written opinion. If any party desires a written opinion, one shall be issued within fifteen (15) days, but its issuance shall not delay compliance with, or enforcement of, the Award. The Permanent Arbitrator may order cessation of the violation of this Article, and such Award shall be served on all parties by hand or registered mail upon issuance.

7.5.E Such Award may be enforced by any court of competent jurisdiction upon the filing of the Award and such other relevant documents as may be required. Facsimile or other hardcopy written notice of the filing of such enforcement proceedings shall be given to the other relevant parties. In a proceeding to obtain a temporary order enforcing the Permanent Arbitrator's Award as issued under this Article, all parties waive the right to a hearing and agree that such proceedings may be ex parte. Such agreement does not waive any party's right to participate in a hearing for a final order of enforcement. The Court's order or orders enforcing the Permanent Arbitrator's Award shall be served on all parties by hand or by delivery to their last known address or by registered mail.

7.6 Individuals found to have violated the provisions of this Article are subject to immediate termination. In addition, IDOT reserves the right to terminate this PLA as to any party found to have violated the provisions of this Article.

7.7 Any rights created by statue or law governing arbitration proceedings inconsistent with the above procedure or which interfere with compliance therewith are hereby waived by parties to whom they accrue.

7.8 The fees and expenses of the Permanent Arbitrator shall be borne by the party or parties found in violation, or in the event no violation is found, such fees and expenses shall be borne by the moving party.

## ARTICLE VIII – TERMS OF AGREEMENT

8.1 If any Article or provision of this Agreement shall be declared invalid, inoperative or unenforceable by operation of law or by any of the above mentioned tribunals of competent jurisdiction, the remainder of this Agreement or the application of such Article or provision to persons or circumstances other than those as to which it has been held invalid, inoperative or unenforceable shall not be affected thereby.

8.2 This Agreement shall be in full force as of and from the date of the Notice of Award until the Project contract is closed.

8.3 This PLA may not be changed or modified except by the subsequent written agreement of the parties. All parties represent that they have the full legal authority to enter into this PLA. This PLA may be executed by the parties in one or more counterparts.

8.4 Any liability arising out of this PLA shall be several and not joint. IDOT shall not be liable to any person or other party for any violation of this PLA by any other party, and no Contractor or Union shall be liable for any violation of this PLA by any other Contractor or Union.

8.5 The failure or refusal of a party to exercise its rights hereunder in one or more instances shall not be deemed a waiver of any such rights in respect of a separate instance of the same or similar nature.

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Addendum A

IDOT Slate of Permanent Arbitrators

1. Bruce Feldacker
2. Thomas F. Gibbons
3. Edward J. Harrick
4. Brent L. Motchan
5. Robert Perkovich
6. Byron Yaffee
7. Glenn A. Zipp

**Execution Page**

***Illinois Department of Transportation***

**VACANT**
Director of Highways Project Implementation

Director of Finance & Administration

Philip Kaufmann, Chief Counsel

Omer Osman, Acting Secretary (Date)

***Illinois AFL-CIO Statewide Project Labor Agreement Committee, representing the Unions listed below:***

(Date)

List Unions:

Exhibit A - Contractor Letter of Assent

(Date)

To All Parties:

In accordance with the terms and conditions of the contract for Construction Work on [Contract No. ], this Letter of Assent hereby confirms that the undersigned Prime Contractor or Subcontractor agrees to be bound by the terms and conditions of the Project Labor Agreement established and entered into by the Illinois Department of Transportation in connection with said Project.

It is the understanding and intent of the undersigned party that this Project Labor Agreement shall pertain only to the identified Project. In the event it is necessary for the undersigned party to become signatory to a collective bargaining agreement to which it is not otherwise a party in order that it may lawfully make certain required contributions to applicable fringe benefit funds, the undersigned party hereby expressly conditions its acceptance of and limits its participation in such collective bargaining agreement to its work on the Project.

(Authorized Company Officer)

(Company)

# STORM WATER POLLUTION PREVENTION PLAN

Illinois Department of Transportation

**Storm Water Pollution Prevention Plan**

| | | | |
|---|---|---|---|
| Route | FAP 346 | Marked Rte. | US 41 at Deerpath Road |
| Section | (21&21S)-I | Project No. | C-91-086-16 |
| County | Lake | Contract No. | 62B65 |

This plan has been prepared to comply with the provisions of the National Pollutant Discharge Elimination System (NPDES) Permit No. ILR10 (Permit ILR10), issued by the Illinois Environmental Protection Agency (IEPA) for storm water discharges from construction site activities.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

| | |
|---|---|
| Anthony Quigley, PE | Signature |
| Print Name | |
| Regional Engineer | 7-12-19 |
| Title | Date |
| IDOT | |
| Agency | |

Note: Guidance on preparing each section of BDE 2342 can be found in Chapter 41 of the IDOT Bureau of Design and Environment Manual. Chapter 41 and this form also reference the IDOT Drainage Manual which should be readily available.

**I. Site Description:**

A. Provide a description of the project location (include latitude and longitude, Section, Town, and Range):

Near the intersection of US Route 41 and Deerpath Road, Lake Forest, IL Latitude 42.247 degrees N, Longitude -87.860 degrees W. The site is located in the NE & NW quarters of Section 32, Township 44 N, Range 12 E of the 3rd P.M., in Lake County, Illinois.

The design, installation, and maintenance of BMPs at these locations are within an area where annual erosivity (R value) is less than or equal to 160. Erosivity is less than 5 in all two-week periods between October 12 and April 15, which would qualify for a construction rainfall erosivity waiver under the US Construction General Permit requirements. At these locations, erosivity is highest in spring to autumn, April 16 - October 11.

B. Provide a description of the construction activity which is the subject of this plan. Include the number of construction stages, drainage improvements, in-stream work, installation, maintenance, removal of erosion measures, and permanent stabilization:

The Illinois Department of Transportation (IDOT) is proposing to replace Pump Station 38 which drains the Deerpath Road underpass at US 41 in the City of Lake Forest. The project includes the reconstruction and relocation of the pump station and appurtenances to a 150' x 150' parcel at the southwest corner of Deerpath Road and Awahnee Lane. Additional improvements include:

A series of two interconnected detention basins to be constructed on Deerpath Golf Course north of Deerpath Road.

Installation of a storm sewer main drain designed to intercept and convey flows from the west side of US 41, to the proposed detention ponds located approximately 275 feet north of Deerpath Road that bypasses the sag at the underpass, various storm sewer removal and replacements and other related drainage improvements along the Deerpath Road and the US 41 entrance and exit ramps.

Safety improvements which include a minor widening of Deerpath Road at the US 41 interchange to provide left-turn lanes onto the US 41 on-ramps.

Various Sidewalk and curb and gutter replacements and the milling and resurfacing of Deerpath Road within the project limits.

The Proposed improvements on Deerpath Road extend approximately 550 feet to the west of US 41, and east to a point approximately 350 feet west of the Skokie River bridge, a distance of 2,400 feet (0.45 miles). The proposed improvements along Deerpath Road are to be completed in two construction stages.

The construction of Pump Station 38 at the southwest corner of Deerpath Road and Ahwahnee Lane and the construction of the two interconnected detention basins on the Deerpath Golf Course will each be completed in a single stage.

Prior to disturbance Temporary Erosion and Sediment Control (ESC) measures are to be installed as specified in this Storm Water Pollution Prevention Plan and in accordance with the Erosion Control Plans. At the completion of each stage of construction when the area controlled has been permanently stabilized (paved or landscaped) the temporary ESC measures will be removed.

There is no in-stream work included in this project.

C. Provide the estimated duration of this project:

24 months.

D. The total area of the construction site is estimated to be 7 acres.

The total area of the site estimated to be disturbed by excavation, grading or other activities is 7 acres.

E. The following are weighted averages of the runoff coefficient for this project before and after construction activities are completed (See Section 4-102 of the IDOT Drainage Manual):

Pump Station 38 Site: C=0.59 (Proposed); C=0.35 (Existing)
Detention Pond No. 1 Site: C=0.43 (Proposed); C=0.35 (Existing)
Detention Pond No. 2 Site: C=0.60 (Proposed); C=0.35 (Existing)
Roadway and sidewalk improvements: C=0.78 (Proposed); C=0.77 (Existing)

F. List all soils found within project boundaries. Include map unit name, slope information, and erosivity:

153A Pella silty clay loam, 0 to 2 percent slopes;
soil erodibility factor (whole soil) Kw = 0.24

320A Frankfort silt loam, 0 to 2 percent slopes;
soil erodibility factor (whole soil) Kw= 0.37

320B Frankfort silt loam, 2 to 4 percent slopes;
soil erodibility factor (whole soil) Kw = 0.37

465A Montgomery silty clay loam, 0 to 2 percent slopes;
soil erodibility factor (whole soil) Kw = 0.28

Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. Erosion factor Kw (whole soil) indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

G. If wetlands were delineated for this project, provide an extent of wetland acreage at the site (See Phase I report):

Wetland Site #2: >0.1 acres / 0.1 acres of impact

H. Provide a description of potentially erosive areas associated with this project:

W. side of US41 SB Exit ramp; N. frontage of PS-38 site along the S. side Deerpath Rd ; Detention Ponds 1 & 2

I. The following is a description of soil disturbing activities by stages, their locations, and their erosive factors (e.g., steepness of slopes, length of slopes, etc.):

1. Excavation of the pit and jacking of the proposed bypass storm sewer under the ComEd high-tension lines and the U.P. Railroad and a portion of the Northbound Entrance Ramp (installation to be continued by open-trenching in the vault below US 41 and across the exit and entrance ramps north of Deerpath Road). The area of surface

disturbance will be small, but there is some potential for sedimentation resulting from the handling of spoils from the auguring operations.
2. Construction of Detention Ponds 1 & 2 within Deerpath Golf Course, together with the interconnecting storm sewer. There will be a high level of soil disturbance over a large area, for a considerable period of time.
3. Construction of the storm sewer and minor widening and other roadway improvements along Deerpath Road. A relatively low level of soil disturbance is anticipated from these activities, which should be easily controlled.
4. Temporary earth retention and excavation for construction of the Pump Station building. The building site construction activities are anticipated to result in a relatively high level of soil disturbance, and the existing and proposed slopes in some areas are 1:3 or steeper, so the risk of erosion is very high.
The building site will be subjected to a very intense level of construction activities, however the area to be controlled is very small.
5. Construct the access drive and parking lot, detached generator building, sidewalks and other site improvements.
6. Removal and relocation of the existing bike path on the pump station site, followed by final stabilization and landscaping activities. Soil disturbance will be confined to a very limited, flat area.

J. See the erosion control plans and/or drainage plans for this contract for information regarding drainage patterns, approximate slopes anticipated before and after major grading activities, locations where vehicles enter or exit the site and controls to prevent offsite sediment tracking (to be added after contractor identifies locations), areas of soil disturbance, the location of major structural and non-structural controls identified in the plan, the location of areas where stabilization practices are expected to occur, surface waters (including wetlands) and locations where storm water is discharged to surface water including wetlands.

K. Identify who owns the drainage system (municipality or agency) this project will drain into:

City of Lake Forest

L. The following is a list of General NPDES ILR40 permittees within whose reporting jurisdiction this project is located.

City of Lake Forest, Lake County, IDOT.

M. The following is a list of receiving water(s) and the ultimate receiving water(s) for this site. In addition, include receiving waters that are listed as Biologically Significant Streams by the IDNR. The location of the receiving waters can be found on the erosion and sediment control plans:

Skokie River, N. Branch Chicago River, Chicago Sanitary and Ship Canal, Illinois River.

N. Describe areas of the site that are to be protected or remain undisturbed. These areas may include steep slopes (i.e., 1:3 or steeper), highly erodible soils, streams, stream buffers, specimen trees, natural vegetation, nature preserves, etc. Include any commitments or requirements to protect adjacent wetlands.

For any storm water discharges from construction activities within 50-feet of Waters of the US (except for activities for water-dependent structures authorized by a Section 404 permit, describe: a) How a 50-foot undisturbed natural buffer will be provided between the construction activity and the Waters of the United States, or b) How additional erosion and sediment controls will be provided within that area.

All areas of the project site will be disturbed. The wetland area adjacent to the site of the proposed Detention Pond No. 2 will be protected by a temporary "no intrusion" fence.
No impacts to the Skokie River Nature Preserve are anticipated since there are no nearby planned construction activities.

O. Per the Phase I document, the following sensitive environmental resources are associated with this project and may have the potential to be impacted by the proposed development. Further guidance on these resources is available in Section 41-4 of the BDE Manual.

☒ 303(d) Listed receiving waters for suspended solids, turbidity, or siltation

The name(s) of the listed water body, and identification of all pollutants causing impairment:

Skokie River, N. Branch Chicago River, Chicago Sanitary and Ship Canal, Illinois River.
Pollutants causing impairment: Oxygen, Dissolved; Phosphorus (Total); Total Suspended Solids (TSS); Fecal Coliform; Bottom Deposits; Chlordane; Chloride; Sedimentation/Siltation; Mercury, Polychlorinated biphenyls, Total Dissolved Solids, Aldrin, DDT, Hexachlorobenzene, Iron, PH.

Provide a description of how erosion and sediment control practices will prevent a discharge of sediment resulting from a storm event equal to or greater than a twenty-five (25) year, twenty-four (24) hour rainfall event:

Runoff from the proposed pump station construction site does not discharge directly by gravity flow to the receivin must be pumped across the catchment subdivide. Therefore, in addition to the temporary erosion control measu excessive sediment can be controlled by settlement at the pump well location pending stabilization of the disturbe the bypass storm sewer construction the two proposed detention ponds can be utilized as temporary settlement bas of the point of discharge to the outfall sewer.

Provide a description of the location(s) of direct discharge from the project site to the 303(d) water body:

Existing storm sewer outfall/headwall on the west bank of Skokie River at the Deerpath Road crossing.

Provide a description of the location(s) of any dewatering discharges to the MS4 and/or water body:
Dewatering systems which may required to excavate the detention pond (No. 2) adjacent to the Skokie River f discharge into the existing storm sewer running northeast to the outfall/headwall on the west bank of the Skokie Deerpath Road crossing.

☐ Applicable Federal, Tribal, State or Local Programs

☒ Floodplain

☐ Historic Preservation

☐ Receiving waters with Total Maximum Daily Load (TMDL) for sediment, total suspended solids, turbidity or siltation

TMDL (fill out this section if checked above)

The name(s) of the listed water body:

Provide a description of the erosion and sediment control strategy that will be incorporated into the site design that is consistent with the assumptions and requirements of the TMDL:

If a specific numeric waste load allocation has been established that would apply to the project's discharges, provide a description of the necessary steps to meet that allocation:

☐ Threatened and Endangered Species/Illinois Natural Areas (INAI)/Nature Preserves

☐ Other

☒ Wetland

An upland, isolated, depressionalwetland with an area of 0.10 acres is located within the project limits.

P. The following pollutants of concern will be associated with this construction project:

☐ Antifreeze / Coolants
☐ Concrete
☐ Concrete Curing Compounds
☒ Concrete Truck Waste
☒ Fertilizers / Pesticides
☐ Paints
☒ Petroleum (gas, diesel, oil, kerosene, hydraulic oil / fluids)
☒ Soil Sediment
☐ Solid Waste Debris
☐ Solvents
☒ Waste water from cleaning construction equipment
☒ Other (specify) Tree Debris
☐ Other (specify)
☐ Other (specify)
☐ Other (specify)
☐ Other (specify)

**II. Controls:**

This section of the plan addresses the controls that will be implemented for each of the major construction activities described in I.C. above and for all use areas, borrow sites, and waste sites. For each measure discussed, the Contractor will be responsible for its implementation as indicated. The Contractor shall provide to the Resident Engineer a plan for the implementation of the measures indicated. The Contractor, and subcontractors, will notify the Resident Engineer of any proposed changes, maintenance, or modifications to keep construction activities compliant with the Permit ILR10. Each such Contractor has signed the required certification on forms which are attached to, and are a part of, this plan:

A. **Erosion and Sediment Controls:** At a minimum, controls must be coordinated, installed and maintained to:

1. Minimize the amount of soil exposed during construction activity;

2. Minimize the disturbance of steep slopes;
3. Maintain natural buffers around surface waters, direct storm water to vegetated areas to increase sediment removal and maximize storm water infiltration, unless infeasible;
4. Minimize soil compaction and, unless infeasible, preserve topsoil.

B. **Stabilization Practices:** Provided below is a description of interim and permanent stabilization practices, including site- specific scheduling of the implementation of the practices. Site plans will ensure that existing vegetation is preserved where attainable and disturbed portions of the site will be stabilized. Stabilization practices may include but are not limited to: temporary seeding, permanent seeding, mulching, geotextiles, sodding, vegetative buffer strips, protection of trees, preservation of mature vegetation, and other appropriate measures. Except as provided below in II(B)(1) and II(B)(2), stabilization measures shall be initiated **immediately** where construction activities have temporarily or permanently ceased, but in no case more than **one (1) day** after the construction activity in that portion of the site has temporarily or permanently ceases on all disturbed portions of the site where construction will not occur for a period of fourteen (14) or more calendar days.

1. Where the initiation of stabilization measures is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.
2. On areas where construction activity has temporarily ceased and will resume after fourteen (14) days, a temporary stabilization method can be used.

The following stabilization practices will be used for this project:

| | | | |
|---|---|---|---|
| ☒ | Erosion Control Blanket / Mulching | ☐ | Temporary Turf (Seeding, Class 7) |
| ☒ | Geotextiles | ☒ | Temporary Mulching |
| ☒ | Permanent Seeding | ☐ | Vegetated Buffer Strips |
| ☒ | Preservation of Mature Vegetation | ☒ | Other (specify) Dust Control |
| ☒ | Protection of Trees | ☒ | Other (specify) Mulch Method 2 |
| ☐ | Sodding | ☐ | Other (specify) |
| ☒ | Temporary Erosion Control Seeding | ☐ | Other (specify) |

Describe how the stabilization practices listed above will be utilized during construction:

Stabilization controls runoff volume and velocity, peak runoff rates and volumes of discharge to minimize exposed soil, disturbed slopes, sediment discharges from construction, and provides for natural buffers and minimization of soil compaction. Existing vegetated areas where disturbance can be avoided will not require stabilization. Where possible, stabilization of the initial Stage should be completed before work is moved to subsquent stages.

Preservation of Mature Vegetation: Mature vegetation will be preserved and maintained where possible.

Protection of Trees: All trees designated to be saved shall be protected prior to the commencement of any clearing or removal work. Protection of trees shall be in accordance with Article 201.05 of the IDOT Standard Specifications for Road and Bridge Construction.

Temporary Mulching: Temporary mulching will be utilized on relatively flat areas designated in the design plans which are to be altered during a later construction phase, to protect from sheet erosion and allow temporary seeding to germinate. This item will also be utilized for areas disturbed during the removal of soil and erosion control measures or as directed by the Engineer.

Temporary Erosion Control Seeding: All exposed surface areas disturbed by construction will be stabilized within seven days utilizing Temporary Erosion Control Seeding. The seed mixture will depend on the time of year it is applied. Winter wheat mix shall replace spring oats mix for temporary seed applied after July 31 and before November 15. This item will also be utilized for areas disturbed during the removal of soil and erosion control measures or as directed by the Engineer.

Erosion Control Blankets: Erosion control blankets will be installed over temporary seeded areas to protect ditches, high velocity areas, and slopes where erosion is a potential problem and allow seeds to germinate.

Dust Control: Dust control measures will be implemented in accordance with Article 107.36 of the IDOT Standard Specifications for Road and Bridge Construction.

Mulch Method 2: Mulch should be applied to slopes for temporary stabilization prior to seasons when Temporary Erosion Control Seeding will not germinate, for example in mid-July or in winter.

Describe how the stabilization practices listed above will be utilized after construction activities have been completed:

Permanent Seeding: Permanent seeding shall be utilized on areas where final grading and shaping have occurred. All disturbed areas identified to receive permanent seeding should be stabilized at each stage prior to moving on to the next stage.

Erosion Control Blankets/Mulching: Erosion control blankets will be installed over permanent seeded areas to protect ditches, high velocity areas, and slopes where erosion is a potential problem and allow seeds to germinate. Mulching will be utilized on relatively flat areas to protect from sheet erosion and allow permanent seeding to germinate.

Geotextiles: Geotextile fabrics shall be used to separate, reinforce, filter, protect and drain the proposed aggregate subgrades at the locations indicated on the plans.

C. **Structural Practices:** Provided below is a description of structural practices that will be implemented, to the degree attainable, to divert flows from exposed soils, store flows or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Such practices may include but are not limited to: perimeter erosion barrier, earth dikes, drainage swales, sediment traps, ditch checks, subsurface drains, pipe slope drains, level spreaders, storm drain inlet protection, rock outlet protection, reinforced soil retaining systems, gabions, and temporary or permanent sediment basins. The installation of these devices may be subject to Section 404 of the Clean Water Act.

The following structural practices will be used for this project:

| | | | |
|---|---|---|---|
| ☐ | Aggregate Ditch | ☒ | Stabilized Construction Exits |
| ☐ | Concrete Revetment Mats | ☐ | Stabilized Trench Flow |
| ☐ | Dust Suppression | ☐ | Slope Mattress |
| ☐ | Dewatering Filtering | ☐ | Slope Walls |
| ☐ | Gabions | ☒ | Temporary Ditch Check |
| ☐ | In-Stream or Wetland Work | ☐ | Temporary Pipe Slope Drain |
| ☐ | Level Spreaders | ☐ | Temporary Sediment Basin |
| ☐ | Paved Ditch | ☐ | Temporary Stream Crossing |
| ☐ | Permanent Check Dams | ☐ | Turf Reinforcement Mats |
| ☒ | Perimeter Erosion Barrier | ☒ | Other (specify) Stabilized Flow Line |
| ☐ | Permanent Sediment Basin | ☒ | Other (specify) Filtration bags on dewatering system outlets |
| ☒ | Retaining Walls | ☒ | Other (specify) Wetland Exclusion Fencing |
| ☒ | Riprap | ☐ | Other (specify) |
| ☐ | Rock Outlet Protection | ☐ | Other (specify) |
| ☒ | Sediment Trap | ☐ | Other (specify) |
| ☒ | Storm Drain Inlet Protection | ☐ | Other (specify) |

Describe how the structural practices listed above will be utilized during construction:

Perimeter Erosion Barrier (PEB): Sediment control silt fence will be placed within the ROW or easement limits adjacent to the construction limits in areas where the ground slopes away from the project site to intercept waterborne silt and prevent it from leaving the construction site. PEB will be set before the commencement of earth disturbing or grading construction activities and remain in place until after all construction activities have been completed. Silt fence will be installed around all temporary topsoil and other stockpiles. Silt fence should only be used as PEB in areas where the work area is higher than the perimeter. The use of silt fence at the top of the slope/elevations higher than the work area should always be avoided. If necessary, temporary fence should be utilized in these locations (where the top of slope/elevation is higher than the work area) in lieu of silt fence.

Temporary Ditch Checks are to be placed in swales where runoff velocity is high or as directed by the Engineer in order to prevent downstream erosion.

Avoid using the INLET AND PIPE PROTECTION shown on the Highway Standard Sheets 280001. Straw bales and silt fence should not be used as inlet and pipe protection. Inlet and pipe protection should be comprised of ditch checks, temporary seeding and temporary erosion control blanket and will be installed at

all storm sewer and culverts. Inlet filters, as specified in Article 1081.15(h) of the Standard Specifications (current edition) will be installed at all inlets, catch basins, and manholes for the duration of construction. Inlet filters will be cleaned on a regular basis. Ensure proper quantities of inlet filters. ditch checks, temporary seeding and temporary erosion control blanket are included in the contract.

Storm Drain Inlet Protection will be utilized at all storm sewers and culverts. Inlet and pipe protection comprised of rolled excelsior log checks, temporary seeding, and erosion control blanket will be provided at the upstream ends of all culverts, at all area drains, and at grated structures draining ditches. Storm drain inlet protection devices will be checked on a periodic basis and any sediment or debris will be removed to maintain inlet protection.

Sediment Traps will be utilized at the pipe outfall ends of proposed detention ponds. The sediment traps will be checked on a periodic basis to remove and re-spread accumulated sediment.

Stabilized Construction Exits shall be installed at various locations within the project limits where construction traffic enters/exits the public road. They shall be constructed to prevent tracking of sediment onto public roadways by construction vehicles and equipment. The contractor will provide the Engineer with a written plan identifying the locations and the procedures (s)he will use to construct and maintain them. All work associated with installation and maintenance of Stabilized Construction Exits, and concrete washouts are incidental to the contract.

Stabilized Flow Line: The Contractor should provide to the RE a plan to ensure that a stabilized flow line will be provided during storm sewer construction. The use of a stabilized flow line between installed storm sewer and open disturbance will reduce the potential for the offsite discharge of sediment bearing waters, particularly when rain is forecasted so that flow will not erode. Lack of an approved plan or failure to comply will result in an ESC Deficiency Deduction.

Filtration Bags on Dewatering System Outlets: Filtration bags shall be attached to pump discharges and surrounded with a secondary containment or on a stabilized area, in accordance with the Illinois Urban Manual Practice Standards.

Wetland Exclusion Fencing: Wetland exclusion fencing shall consist of temporary fence and "Wetland No Intrusion" signage to be provided at the boundary of all un-impacted wetlands within/immediately adjacent to the ROW or easement boundary.

Describe how the structural practices listed above will be utilized after construction activities have been completed:

Riprap: Stone riprap will be provided on the discharge sections at all storm sewer outlets, to reduce the velocity and energy of the concentrated flows. This will help prevent scour and erosion at the outlet, and minimize the potential for downstream erosion.

Retaining Walls: The proposed retaining walls will negate the need for steep earthen slopes, thereby reducing erosion effects in the supported areas.

D. **Treatment Chemicals**

Will polymer flocculants or treatment chemicals be utilized on this project: ☐ Yes ☒ No

If *yes* above, identify where and how polymer flocculants or treatment chemicals will be utilized on this project.

E. **Permanent (i.e., Post-Construction) Storm Water Management Controls:** Provided below is a description of measures that will be installed during the construction process to control volume and pollutants in storm water discharges that will occur after construction operations have been completed. The installation of these devices may be subject to Section 404 of the Clean Water Act.

1. Such practices may include but are not limited to: storm water detention structures (including wet ponds), storm water retention structures, flow attenuation by use of open vegetated swales and natural depressions, infiltration of runoff on site, and sequential systems (which combine several practices).

The practices selected for implementation were determined based on the technical guidance in Chapter 41 (Construction Site Storm Water Pollution Control) of the IDOT Bureau of Design and Environment Manual. If practices other than those discussed in Chapter 41 are selected for implementation or if practices are applied to situations different from those covered in Chapter 41, the technical basis for such decisions will be explained below.

2. Velocity dissipation devices will be placed at discharge locations and along the length of any outfall channel as necessary to provide a non-erosive velocity flow from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected (e.g., maintenance of hydrologic conditions such as the hydroperiod and hydrodynamics present prior to the initiation of construction activities).

Description of permanent storm water management controls:

Storm Water Detention Ponds: The storm water wet bottom detention ponds will be used to capture and detain runoff from the site post construction. The facilities will detain runoff for a sufficient period of time to allow sediment to drop out of suspension prior to discharge through a control structure.

Riprap: Stone riprap will be provided on the discharge sections at all storm sewer outlets, to reduce the velocity and energy of the concentrated flows. This will help prevent scour and erosion at the outlet, and minimize the potential for downstream erosion.

Trash Rack at Pump Station Inlet Chamber: A trash rack will be provided to capture large debris prior to entering the pumped storm water system.

F. **Approved State or Local Laws:** The management practices, controls and provisions contained in this plan will be in accordance with IDOT specifications, which are at least as protective as the requirements contained in the Illinois Environmental Protection Agency's Illinois Urban Manual. Procedures and requirements specified in applicable sediment and erosion site plans or storm water management plans approved by local officials shall be described or incorporated by reference in the space provided below. Requirements specified in sediment and erosion site plans, site permits, storm water management site plans or site permits approved by local officials that are applicable to protecting surface water resources are, upon submittal of an NOI, to be authorized to discharge under the Permit ILR10 incorporated by reference and are enforceable under this permit even if they are not specifically included in the plan.

Description of procedures and requirements specified in applicable sediment and erosion site plans or storm water management plans approved by local officials:

All management practices, controls, and other provisions provided in this plan are in accordance with the current edition of the IDOT Standard Specifications for Bridge and Road Construction, IDOT Supplemental Specifications and Recurring Special Provisions, the Illinois Environmental Protection Agency's Illinois Urban Manual, and the City of Lake Forest requirements.

G. **Contractor Required Submittals:** Prior to conducting any professional services at the site covered by this plan, the Contractor and each subcontractor responsible for compliance with the permit shall submit to the Resident Engineer a Contractor Certification Statement, BDE 2342a.

1. The Contractor shall provide a construction schedule containing an adequate level of detail to show major activities with implementation of pollution prevention BMPs, including the following items:

- Approximate duration of the project, including each stage of the project
- Rainy season, dry season, and winter shutdown dates
- Temporary stabilization measures to be employed by contract phases
- Mobilization timeframe
- Mass clearing and grubbing/roadside clearing dates
- Deployment of Erosion Control Practices
- Deployment of Sediment Control Practices (including stabilized construction entrances/exits)
- Deployment of Construction Site Management Practices (including concrete washout facilities, chemical storage, refueling locations, etc.)
- Paving, saw-cutting, and any other pavement related operations
- Major planned stockpiling operations
- Timeframe for other significant long-term operations or activities that may plan non-storm water discharges such as dewatering, grinding, etc.
- Permanent stabilization activities for each area of the project

2. During the pre-construction meeting, the Contractor and each subcontractor shall provide, as an attachment to their signed Contractor Certification Statement, a discussion of how they will comply with the requirements of the permit in regard to the following items and provide a graphical representation showing location and type of BMPs to be used when applicable:

   - Temporary Ditch Checks - Identify what type and the source of Temporary Ditch Checks that will be installed as part of the project. The installation details will then be included with the SWPPP.
   - Vehicle Entrances and Exits – Identify type and location of stabilized construction entrances and exits to be used and how they will be maintained.
   - Material Delivery, Storage and Use – Discuss where and how materials including chemicals, concrete curing compounds, petroleum products, etc. will be stored for this project.
   - Stockpile Management – Identify the location of both on-site and off-site stockpiles. Discuss what BMPs will be used to prevent pollution of storm water from stockpiles.
   - Waste Disposal – Discuss methods of waste disposal that will be used for this project.
   - Spill Prevention and Control – Discuss steps that will be taken in the event of a material spill (chemicals, concrete curing compounds, petroleum, etc.)
   - Concrete Residuals and Washout Wastes – Discuss the location and type of concrete washout facilities to be used on this project and how they will be signed and maintained.
   - Litter Management – Discuss how litter will be maintained for this project (education of employees, number of dumpsters, frequency of dumpster pick-up, etc.).
   - Vehicle and Equipment Fueling – Identify equipment fueling locations for this project and what BMPs will be used to ensure containment and spill prevention.
   - Vehicle and Equipment Cleaning and Maintenance – Identify where equipment cleaning and maintenance locations for this project and what BMPs will be used to ensure containment and spill prevention.
   - Dewatering Activities – Identify the controls which will be used during dewatering operations to ensure sediments will not leave the construction site.
   - Polymer Flocculants and Treatment Chemicals – Identify the use and dosage of treatment chemicals and provide the Resident Engineer with Material Safety Data Sheets. Describe procedures on how the chemicals will be used and identify who will be responsible for the use and application of these chemicals. The selected individual must be trained on the established procedures.
   - Additional measures indicated in the plan.

**III. Maintenance:**

When requested by the Contractor, the Resident Engineer will provide general maintenance guides (e.g., IDOT Erosion and Sediment Control Field Guide) to the Contractor for the practices associated with this project. Describe how all items will be checked for structural integrity, sediment accumulation and functionality. Any damage or undermining shall be repaired immediately. Provide specifics on how repairs will be made. The following additional procedures will be used to maintain, in good and effective operating conditions, the vegetation, erosion and sediment control measures and other protective measures identified in this plan. It will be the Contractor's responsibility to attain maintenance guidelines for any manufactured BMPs which are to be installed and maintained per manufacture's specifications.

All erosion sediment control measures will be maintained in accordance with the IDOT Erosion and Sediment Control Field Guide for Construction Inspection:
http://www.idot.illinois.gov/transportation-system/environment/erosion-and-sediment-control
and in accordance with IDOT's Best Management Practices-Maintenance Guides:
http://www.idot.illinois.gov/transportation-system/environment/erosion-and-sediment-control
Any damage or undermining of measures shall be immediately repaired. All maintenance of Erosion and Sediment Control (ESC) systems is the responsibility of the Contractor.
The Contractor shall check all Erosion and Sediment Control (ESC) measures weekly and after each rainfall 0.5 inches or greater in a 24 hour period, or equivalent snowfall. Additionally during winter months, all measures should be checked by the Contractor after each significant snowmelt.

Storm Drain Inlet Protection: Inlet filters will be checked on a periodic basis. Remove sediment when build-up in filter basket exceeds 25% or silt is present over more than 50% of the fabric pores. Keep roadway surfaces free of ponded water. Filters shall remain free of trash on or around their surface. During cleaning inspect filter for tears and replace as warranted. Inspect and maintain items installed as inlet and pipe protection such ditch checks, temporary seeding and temporary erosion control blanket utilizing the procedures described herein.
Temporary Erosion Control Seeding: Continue to reapply seed until stabilization has occurred. Temporary mulch shall be utilized if seed has been washed away or found to be concentrated in ditch bottoms.

Permanent Seeding: Protect the planted area from human, animal and vehicular traffic until the stand is adequately established. Inspect all planted areas for failures and make necessary repairs, replacements, reseedings, and remulching within the planting season, if possible. After the period of establishment, areas not exhibiting 75% uniform growth shall be interseeded or reseeded. Immediately restore rills greater than 4 inches deep on slopes steeper than 1V:4H. When excessive weeds develop, mow to promote seed soil contact. Supplemental watering shall be provided as needed according to Article 250.07.

Temporary Mulching: Straw shall be repaired if blown or washed away. In locations where the mulch does not control the erosion, use erosion control blanket or tackifier.

Erosion Control Blanket: Repair damage due to water running beneath the blanket. Re-seed wherever necessary. Replace all displaced erosion control blanket and re-staple.
All erosion sediment control measures will be maintained in accordance with the IDOT Erosion and Sediment Control Field Guide for Construction Inspection:
http://www.idot.illinois.gov/transportation-system/environment/erosion-and-sediment-control
and in accordance with IDOT's Best Management Practices-Maintenance Guides:
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Temporary Mulching: Straw shall be repaired if blown or washed away. In locations where the mulch does not control the erosion, use erosion control blanket or tackifier.

Erosion Control Blanket: Repair damage due to water running beneath the blanket. Re-seed wherever necessary. Replace all displaced erosion control blanket and re-staple.
Perimeter Erosion Barrier: Inspect barrier for tears, gaps, undermining, leaning, missing or broken stakes. Restore, repair or replace immediately. Ensure barrier remains taut. Should sediment reach 1/3 of the height of the barrier, maintenance or replacement is required.

Temporary Ditch Checks: Remove sediment from upstream side of ditch checks when the sediment has reached 50% of the height of the structure. Repair or replace ditch checks whenever tears, splits, unraveling or compressed excelsior is noticed. Ensure ditch checks remain free of debris. Reestablish the flow over the center of the ditch check. Water or sediment going around the ditch check indicates incorrect installation. Device needs lengthening or the selected device is inappropriate for the site conditions.

Outlet Protection (Riprap): Restore dislodged protection at outlet structures and correct erosion that may occur. Remove sediment buildup that deposits in the protection. Remedy deficient areas, prone to increased erosion, immediately to prevent greater deficiencies. Remove sediment when voids are full and replace protection. Protection is reusable if the accumulated sediment is removed.

Stabilized Construction Entrance: The entrance shall be maintained in a condition that will prevent tracking of sediment onto public right-of-way or streets. Replenish stone or replace exit if vehicles continue to track
sediment onto the roadway. Periodic inspections and needed maintenance shall be provided after significant rainfall events.

Sediment Traps: Maintenance work for this item shall consist of removal of trapped sediment when trap becomes 50% full. Trapped sediment and accumulated silt shall be disposed of according to Article 202.03.
Perimeter Erosion Barrier: Inspect barrier for tears, gaps, undermining, leaning, missing or broken stakes. Restore, repair or replace immediately. Ensure barrier remains taut. Should sediment reach 1/3 of the height of the barrier, maintenance or replacement is required.

Temporary Ditch Checks: Remove sediment from upstream side of ditch checks when the sediment has reached 50% of the height of the structure. Repair or replace ditch checks whenever tears, splits, unraveling or compressed excelsior is noticed. Ensure ditch checks remain free of debris. Reestablish the flow over the center of the ditch check. Water or sediment going around the ditch check indicates incorrect installation. Device needs lengthening or the selected device is inappropriate for the site conditions.

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Stabilized Construction Entrance: The entrance shall be maintained in a condition that will prevent tracking of sediment onto public right-of-way or streets. Replenish stone or replace exit if vehicles continue to track
sediment onto the roadway. Periodic inspections and needed maintenance shall be provided after significant rainfall events.

Sediment Traps: Maintenance work for this item shall consist of removal of trapped sediment when trap becomes 50% full. Trapped sediment and accumulated silt shall be disposed of according to Article 202.03.

**IV. Inspections:**

Qualified personnel shall inspect disturbed areas of the construction site including Borrow, Waste, and Use Areas, which have not yet been finally stabilized, structural control measures, and locations where vehicles and equipment enter and exit the site using IDOT Storm Water Pollution Prevention Plan Erosion Control Inspection Report (BC 2259). Such inspections shall be conducted at least once every seven (7) calendar days and within twenty-four (24) hours of the end of a storm or by the end of the following business or work day that is 0.5 inch or greater or equivalent snowfall.

Inspections may be reduced to once per month when construction activities have ceased due to frozen conditions. Weekly inspections will recommence when construction activities are conducted, or if there is 0.5" or greater rain event, or a discharge due to snowmelt occurs.

If any violation of the provisions of this plan is identified during the conduct of the construction work covered by this plan, the Resident Engineer shall notify the appropriate IEPA Field Operations Section office by email at: epa.swnoncomp@illinois.gov, telephone or fax within twenty-four (24) hours of the incident. The Resident Engineer shall then complete and submit an "Incidence of Non-Compliance" (ION) report for the identified violation within five (5) days of the incident. The Resident Engineer shall use forms provided by IEPA and shall include specific information on the cause of noncompliance, actions which were taken to prevent any further causes of noncompliance, and a statement detailing any environmental impact which may have resulted from the noncompliance. All reports of non-compliance shall be signed by a responsible authority in accordance with Part VI. G of the Permit ILR10.

The Incidence of Non-Compliance shall be mailed to the following address:

Illinois Environmental Protection Agency
Division of Water Pollution Control
Attn: Compliance Assurance Section
1021 North Grand East
Post Office Box 19276
Springfield, Illinois 62794-9276

**V. Failure to Comply:**

Failure to comply with any provisions of this Storm Water Pollution Prevention Plan will result in the implementation of a National Pollutant Discharge Elimination System/Erosion and Sediment Control Deficiency Deduction against the Contractor and/or penalties under the Permit ILR10 which could be passed on to the Contractor.

Illinois Department of Transportation

## Contractor Certification Statement

Prior to conducting any professional services at the site covered by this contract, the Contractor and every subcontractor must complete and return to the Resident Engineer the following certification. A separate certification must be submitted by each firm. Attach to this certification all items required by Section II.G of the Storm Water Pollution Prevention Plan (SWPPP) which will be handled by the Contractor/subcontractor completing this form.

| | | | |
|---|---|---|---|
| Route | FAP 346 | Marked Rte. | US 41 at Deerpath Road |
| Section | (21&21S)-I | Project No. | C-91-086-16 |
| County | Lake | Contract No. | 62B65 |

This certification statement is a part of SWPPP for the project described above, in accordance with the General NPDES Permit No. ILR10 issued by the Illinois Environmental Protection Agency.

I certify under penalty of law that I understand the terms of the Permit No. ILR 10 that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

In addition, I have read and understand all of the information and requirements stated in SWPPP for the above mentioned project; I have received copies of all appropriate maintenance procedures; and, I have provided all documentation required to be in compliance with the Permit ILR10 and SWPPP and will provide timely updates to these documents as necessary.

☐ Contractor

☐ Sub-Contractor

| | |
|---|---|
| Print Name | Signature |
| Title | Date |
| Name of Firm | Telephone |
| Street Address | City/State/ZIP |

Items which this Contractor/subcontractor will be responsible for as required in Section II.G. of SWPPP:

**USACE SECTION 404 PERMIT**

**DEPARTMENT OF THE ARMY**
CHICAGO DISTRICT, CORPS OF ENGINEERS
231 SOUTH LASALLE STREET
CHICAGO, ILLINOIS 60604-1437

REPLY TO
ATTENTION OF:

February 6, 2020

Technical Services Division
Regulatory Branch
LRC-2019-738

SUBJECT: Authorization for 0.1 acres of wetland impacts for drainage and roadway improvements near interchange of US 41 and Deerpath Road, Lake Forest, Lake County, Illinois (Latitude 42.24712, Longitude -87.86218)

Anthony Quigley
Illinois Department of Transportation
201 West Center Court
Schaumburg, Illinois 60196

Dear Mr. Quigley:

This office has verified that your proposed activity complies with the terms and conditions of Regional Permit 3 and the General Conditions for all activities authorized under the Regional Permit Program.

This verification expires three (3) years from the date of this letter and covers only your activity as described in your notification and as shown on the plans entitled "Plan and Profile Deerpath Road", dated 8 August 2019, prepared by Knight Engineers and Architects. Caution must be taken to prevent construction materials and activities from impacting waters of the United States beyond the scope of this authorization. If you anticipate changing the design or location of the activity, you should contact this office to determine the need for further authorization.

The activity may be completed without further authorization from this office provided the activity is conducted in compliance with the terms and conditions of the RPP, including conditions of water quality certification issued under Section 401 of the Clean Water Act by the Illinois Environmental Protection Agency (IEPA). If the design, location, or purpose of the project is changed, you should contact this office to determine the need for further authorization.

The following special conditions are a requirement of your authorization:

1. You shall undertake and complete the project as described in the plans titled, "Plan and Profile Deerpath Road", dated 8 August 2019, prepared by Knight Engineers and Architects and, including all relevant documentation to the project plans as proposed.

2. This authorization is contingent upon implementing and maintaining soil erosion and sediment controls in a serviceable condition throughout the duration of the project. You shall comply with the project's soil erosion and sediment control (SESC) plans and the installation and

maintenance requirements of the SESC practices on-site. You shall notify this office any changes or modifications to the approved plan set. Please be aware that field conditions during project construction may require the implementation of additional SESC measures for further protection of aquatic resources. If you fail to implement corrective measures, this office may require more frequent site inspections to ensure the installed SESC measures are acceptable. Please be aware that work authorized herein may not commence until you receive written notification from this office that your plans meet technical standards.

As part of the soil erosion and sediment control (SESC) process, you are required to retain a qualified Independent SESC Inspector (ISI) to review the project's SESC plans and provide a detailed narrative that explains the measures to be implemented at the project site. The ISI is also required to perform site inspections of the implemented SESC measures to ensure proper installation and regular maintenance of the approved methods.

You are required to retain a qualified Independent SESC Inspector (ISI). The following requirements apply:

a. You shall contact this office and the ISI at least 10 calendar days prior to the preconstruction meeting so that a representative of this office may attend. The meeting agenda will include a discussion of the SESC plan and the installation and maintenance requirements of the SESC practices on the site;
b. Prior to commencement of any in-stream work, you shall submit construction plans and a detailed narrative to this office that disclose the contractor's preferred method of cofferdam and dewatering method;
c. The ISI will perform weekly inspections of the implemented SESC measures to ensure proper installation and regular maintenance of the approved methods. The ISI contact information form shall be submitted to this office via e-mail and/or hard copy prior to commencement of the permitted work;
d. The ISI shall submit to the Corps an inspection report with digital photographs of the SESC measures on a weekly basis during the active and non-active phases of construction. An inspection report shall also be submitted at the completion of the project once the SESC measures have been removed and final stabilization has been completed; and
e. Field conditions during project construction may require the implementation of additional SESC measures not included in the SESC plans for further protection of aquatic resources. You shall contact this office immediately in the event of any changes or modifications to the approved plan set or non-compliance of an existing SESC method. Upon direction of the Corps, corrective measure shall be instituted at the site to resolve the problem along with a plan to protect and/or restore the impacted jurisdictional area(s). If you fail to implement corrective measures, this office may require more frequent site inspections to ensure the installed SESC measures are acceptable.

3. Under no circumstances shall the Contractor prolong final grading and shaping so that the entire project can be permanently seeded at one time. Permanent stabilization within the wetland and stream buffers identified in the plans shall be initiated immediately following the completion of work. Final stabilization of these areas should not be delayed due to utility

work to be performed by others.

4. Please note that this site is within the aboriginal homelands of several American Indian Tribes. If any cultural, archaeological or historical resources are unearthed during activities authorized by this permit, work in that area must be stopped immediately and the Corps, State Historic Preservation Office and/or Tribal Historic Preservation Office must be contacted for further instruction. The Corps will initiate the coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing on the National Register of Historic Places.

5. You are responsible for all work authorized herein and for ensuring that all contractors are aware of the terms and conditions of this authorization.

6. A copy of this authorization must be present at the project site during all phases of construction.

7. You shall notify this office of any proposed modifications to the project, including revisions to any of the plans or documents cited in this authorization. You must receive approval from this office before work affected by the proposed modification is performed.

8. You shall notify this office prior to the transfer of this authorization and liabilities associated with compliance with its terms and conditions.

This office is in receipt of a copy of the IDOT credit Ledger for Sauk Trail Wetland Mitigation Bank confirming your debit of 0.15 acres of mitigation credits.

This verification does not obviate the need to obtain all other required Federal, state, or local approvals before starting work. Please note that Section 401 Water Quality Certification has been issued by IEPA for this RP. If you have any questions regarding Section 401 certification, please contact Mr. Darin LeCrone at IEPA Division of Water Pollution Control, Permit Section #15, by telephone at (217) 782-0610.

Once you have completed the authorized activity, please sign and return the enclosed compliance certification. If you have any questions, please contact Mr. Aaron Spencer of my staff by telephone at (312) 846-5540, or email at Aaron.D.Spencer@usace.army.mil.

Sincerely,

CHERNICH.KATHLEEN.G.1230365616 Digitally signed by CHERNICH.KATHLEEN.G.1230365616 Date: 2020.02.06 10:08:02 -06'00'

Kathleen G. Chernich
Chief, East Section
Regulatory Branch

Enclosures

Copy Furnished:

Lake County Stormwater Management Commission (Kurt Woolford)
McHenry-Lake County SWCD (Ed Weskerna)
City of Lake Forest (Robert Ellis)
IDOT (Ken Eng)

**PERMIT COMPLIANCE**

**CERTIFICATION**

Permit Number: LRC-2019-738

Permittee: Anthony Quigley
Illinois Department of Transportation

Date: February 6, 2020

I hereby certify that the work authorized by the above-referenced permit has been completed in accordance with the terms and conditions of said permit and if applicable, compensatory wetland mitigation was completed in accordance with the approved mitigation plan.[1]

_____ _____
PERMITTEE DATE

Upon completion of the activity authorized by this permit and any mitigation required by the permit, this certification must be signed and returned to the following address:

U.S. Army Corps of Engineers
Chicago District, Regulatory Branch
231 South LaSalle Street, Suite 1500
Chicago, Illinois 60604-1437

Please note that your permitted activity is subject to compliance inspections by Corps of Engineers representatives. If you fail to comply with this permit, you may be subject to permit suspension, modification, or revocation.

[1] If compensatory mitigation was required as part of your authorization, you are certifying that the mitigation area has been graded and planted in accordance with the approved plan. You are acknowledging that the maintenance and monitoring period will begin after a site inspection by a Corps of Engineers representative or after thirty days of the Corps' receipt of this certification. You agree to comply with all permit terms and conditions, including additional reporting requirements, for the duration of the maintenance and monitoring period.

US Army Corps of Engineers®
Chicago District

**GENERAL CONDITIONS
APPLICABLE TO THE 2017
REGIONAL PERMIT PROGRAM**

The permittee must comply with the terms and conditions of the Regional Permits and the following general conditions for all activities authorized under the RPP:

1. State 401 Water Quality Certification - Water quality certification under Section 401 of the Clean Water Act may be required from the Illinois Environmental Protection Agency (IEPA). The District may consider water quality, among other factors, in determining whether to exercise discretionary authority and require an Individual Permit. Please note that Section 401 Water Quality Certification is a requirement for projects carried out in accordance with Section 404 of the Clean Water Act. Projects carried out in accordance with Section 10 of the Rivers and Harbors Act of 1899 do not require Section 401 Water Quality Certification

On February 16, 2017, the IEPA granted Section 401 certification, with conditions, for all Regional Permits, except for activities in certain waterways noted under RPs 4 and 8. The following conditions of the certification are hereby made conditions of the RPP:

1. The applicant must not cause:
   a) a violation of applicable water quality standards of the Illinois Pollution Control Board Title 35, Subtitle C: Water Pollution Rules and Regulations;
   b) water pollution defined and prohibited by the Illinois Environmental Protection Act;
   c) interference with water use practices near public recreation areas or water supply intakes;
   d) a violation of applicable provisions of the Illinois Environmental Protection Act.
2. The applicant must provide adequate planning and supervision during the project construction period for implementing construction methods, processes and cleanup procedures necessary to prevent water pollution and control erosion.
3. Except as allowed under condition 7, 9 and 10, any spoil material excavated, dredged or otherwise produced must not be returned to the waterway but must be deposited in a self-contained area in compliance with all state statutes, regulations and permit requirements with no discharge to waters of the State unless a permit has been issued by the Illinois EPA. Any backfilling must be done with clean material and placed in a manner to prevent violation of applicable water quality standards.
4. All areas affected by construction must be mulched and seeded as soon after construction as possible. The applicant shall undertake necessary measures and procedures to reduce erosion during construction. Interim measures to prevent erosion during construction shall be taken and may include the installation of staked straw bales, sedimentation basins and temporary mulching. All construction within the waterway shall be constructed during zero or low flow conditions. The applicant shall be responsible for obtaining a NPDES Storm Water Permit prior to initiating construction if the construction activity associated with the project will result in the disturbance of (1) one or more acres, total land area. An NPDES Storm Water Permit may be obtained by submitting a properly completed Notice of Intent (NOI) form by certified mail to the Illinois EPA's Division of Water Pollution Control, Permit Section.
5. The applicant shall implement erosion control measures consistent with the "Illinois Urban Manual" (IEPA/USDA, NRCS; 2016).
6. The applicant is advised that the following permits(s) must be obtained from the Illinois EPA: The applicant must obtain permits to construct sanitary sewers, water mains and related facilities prior to construction.
7. Backfill used in stream crossing trenches shall be predominantly sand or larger size material, with less than 20% passing a #230 U.S. sieve.
8. Any channel relocation shall be constructed under dry conditions and stabilized to prevent erosion prior to the diversion of flow.
9. Backfill used within trenches passing through surface waters of the State, except wetland areas, shall be clean course aggregate, gravel or other material which will not cause siltation, pipe damage during placement, or chemical corrosion in place. Excavated material may be used only if:
   a) particle size analysis is conducted and demonstrates the material to be at least 80% sand or larger size material, using #230 U.S. sieve; or

b) excavation and backfilling are done under dry conditions.

10. Backfill used within trenches passing through wetland areas shall consist of clean material which will not cause siltation, pipe damage during placement, or chemical corrosion in place. Excavated material shall be used to the extent practicable, with the upper six (6) to twelve (12) inches backfilled with the topsoil obtained during trench excavation.

11. Any applicant proposing activities in a mined area or previously mined area shall provide to the IEPA a written determination regarding the sediment and materials used which are considered "acid-producing material" as defined in 35 Il. Adm. Code, Subtitle D. If considered "acid-producing material," the applicant shall obtain a permit to construct pursuant to 35 Il. Adm. Code 404.101.

12. Asphalt, bituminous material and concrete with protruding material such as reinforcing bar or mesh shall not be 1) used for backfill, 2) placed on shorelines/stream banks, or 3) placed in waters of the State.

13. Applicants that use site dewatering techniques in order to perform work in waterways for construction activities approved under Regional Permits 1 (Residential, Commercial and Institutional Developments), 2 (Recreation Projects), 3 (Transportation Projects), 7 (Temporary Construction Activities), 9 (Maintenance), or 12 (Bridge Scour Protection) shall maintain flow in the stream during such construction activity by utilizing dam and pumping, fluming, culverts or other such techniques.

14. In addition to any action required of the Regional Permit 13 (Cleanup of Toxic and Hazardous Materials Projects) with respect to the "Notification" General Condition 23, the applicant shall notify the Illinois EPA Bureau of Water, of the specific activity. This notification must include information concerning the orders and approvals that have been or will be obtained from the Illinois EPA Bureau of Land (BOL) for all cleanup activities under BOL jurisdiction, or for which authorization or approval is sought from BOL for no further remediation. This Regional Permit is not valid for activities that do not require or will not receive authorization or approval from the BOL.

15. The applicant shall implement Best Management Practices (BMPs) to protect water quality, preserve natural hydrology and minimize the overall impacts to aquatic resources during and after construction. If the project involves a water with an approved Total Maximum Daily Load (TMDL) allocation for any parameter, measures which ensure consistency with the assumption and requirements of the TMDL shall be included. TMDL program information and water listings are available at http://www.epa.illinois.gov/topics/water-quality/watershed-management/tmdls/index. If the project involves and impaired water listed on the Illinois Environmental Protection Agency's Section 303(d) list for suspended solids, turbidity, or siltation, measures designed for at least a 25-year, 24-hour rainfall event shall be incorporated. Impaired waters are identified at http://www.epa.illinois.gov/topics/water-quality/watershed-management/tmdls/303d-list/index.

16. Earthen granular fill used for construction of temporary structures in waters of the State shall have less than 20% passing a #230 U.S. sieve.

17. The use of directional drilling to install utility pipelines below surface waters of the State is hereby certified provided that:

    a) All pits and other construction necessary for the directional drilling process are located outside of surface waters of the State;
    b) All drilling fluids shall be adequately contained such that they cannot cause a discharge to surface waters of the State. Such fluids shall be managed such that they are not discharged to waters of the State and disposed of appropriately in accordance with the regulations at 35 Il. Adm. Code Subtitle G.
    c) Erosion and sediment control is provided with Conditions 2, 4, and 5.

2. Illinois Coastal Management Program - Any non-federal entity applying to the Corps for an Individual Permit or a Letter of Permission for a project located within the boundary of the Illinois Coastal Management Program (ICMP), including waters of Lake Michigan, is required to submit a Federal Consistency Determination confirmation from the Illinois Coastal Management Program as part of the permit review process.

On February 18, 2017, the Illinois Department of Natural Resources, Coastal Management Program granted the Federal Consistent Determination for the Regional Permit Program. This determination is confirmation that the activities covered under the Regional Permit Program are consistent with the policies of the ICMP.

PDF maps of the Illinois Coastal Management Program's Zone Boundaries can be found at the bottom of the page at www.dnr.illinois.gov/cmp/Pages/boundaries.aspx and instructions on requesting an ICMP Federal Consistency Determination can be found at www.dnr.illinois.gov/cmp/Documents/ICMPFederalConsistencyReviewProcedures.pdf.

3. Threatened and Endangered Species –

a) For applications where a Federal agency other than the District is designated as the lead agency, the designated lead agency shall follow agency specific procedures for complying with the requirements of Section 7 of the Endangered Species Act of 1973 (Act). Federal permittees must provide the District with the following documentation to demonstrate compliance with those requirements: the species list, your effects determination for each species, and the rationale for your effects determination for each species.

b) For non-Federal permittees, if the District determines that the activity may affect Federally listed species or critical habitat, the District must initiate section 7 consultation with the U.S. Fish and Wildlife Service (USFWS) in accordance with the Endangered Species Act of 1973, as amended (Act). Applicants must provide additional information that would enable the District to conclude that the proposed action will have no effect on Federally listed species.

The application packet must indicate whether resources (species, their suitable habitats, or critical habitat) listed or designated under the Act, may be present within areas affected (directly or indirectly) by the proposed project. Applicants must provide a section 7 species list for the action area using the on-line process at the USFWS website. You can access "U.S. Fish and Wildlife Service Endangered Species Program of the Upper Midwest" website at www.fws.gov/midwest/Endangered. Click on the section 7 Technical Assistance green shaded box in the lower right portion of the screen and follow the instructions to completion. Review all documentation pertaining to the species list and provide your effects determination for each species along with the rationale for your effects determination for each species to this office for review.

If no species, their suitable habitats, or critical habitats are listed, then a “no effect” determination can be made, and section 7 consultation is not warranted. If species or critical habitat appear on the list or suitable habitat is present within the action area, then a biological assessment or biological evaluation will need to be completed to determine if the proposed action will have “no effect” or “may affect” the species or suitable habitat. The District must request initiation of section 7 consultation with the USFWS upon agreement with the applicant on the effect determinations in the biological assessment or biological evaluation.

If the issues are not resolved, the analysis of the situation is complicated, or impacts to listed species or critical habitat are found to be greater than minimal, the District will consider reviewing the project under the Individual Permit process.

Projects in Will, DuPage, or Cook Counties that are located in the recharge zones for Hine’s emerald dragonfly critical habitat units may be reviewed under the RPP, with careful consideration due to the potential impacts to the species. All projects reviewed that are located within 3.25 miles of a critical habitat unit will be reviewed under Category II of the RPP. Please visit the following website for the locations of the Hine’s emerald dragonfly critical habitat units in Illinois. www.fws.gov/midwest/endangered/insects/hed/FRHinesFinalRevisedCH.html

4. Historic Properties - In cases where the District determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity may require an Individual Permit. A determination of whether the activity may be authorized under the RPP instead of an Individual Permit will not be made until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

Federal permittees designated as the lead agency shall follow agency specific procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the District with the appropriate documentation to demonstrate compliance with those requirements.

Non-Federal permittees must include notification to the District if the authorized activity may have the potential to cause effects to any historic properties listed, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the permit application must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)).

When reviewing permit submittals, the District will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. Based on the information submitted and these efforts, the District will determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties which the activity may have the potential to cause effects and so notified the District,

the non-Federal applicant must not begin the activity until notified by the District either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

The District must take into account the effects on such properties in accordance with 33 CFR Part 325, Appendix C, and 36 CFR 800. If all issues pertaining to historic properties have been resolved through the consultation process to the satisfaction of the District, Illinois State Historic Preservation Officer (SHPO) and Advisory Council on Historic Preservation, the District may, at its discretion, authorize the activity under the RPP.

Applicants are encouraged to obtain information on historic properties from the SHPO and the National Register of Historic Places at the earliest stages of project planning. For information, contact:

Illinois State Historic Preservation Office
Illinois Department of Natural Resources
Attn: Review & Compliance
Old State Capital
1 Natural Resources Way
Springfield, IL 62702
(217) 782-4836
https://www2.illinois.gov/dnrhistoric/Pages/default.aspx

If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity, you must immediately notify this office of what you have found, and to the maximum extent practicable, stop activities that would adversely affect those remains and artifacts until the required coordination has been completed. The District will initiate the Federal, Tribal and State coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

5. Soil Erosion and Sediment Control - Measures must be taken to control soil erosion and sedimentation at the project site to ensure that sediment is not transported to waters of the U.S. during construction. Soil erosion and sediment control measures must be implemented before initiating any clearing, grading, excavating or filling activities. All temporary and permanent soil erosion and sediment control measures must be maintained throughout the construction period and until the site is stabilized. All exposed soil and other fills, and any work below the ordinary high water mark must be permanently stabilized at the earliest practicable date.

Applicants are required to prepare a soil erosion and sediment control (SESC) plan including temporary best management practices (BMPs) to be implemented during construction. It is recommended that the plan be designed in accordance with the Illinois Urban Manual, current edition (www.aiswcd.org/illinois-urban-manual). Practice standards and specifications for measures outlined in the soil erosion and sediment control plans should follow the latest edition of the "Illinois Urban Manual: A Technical Manual Designed for Urban Ecosystem Protection and Enhancement." Additional SESC measures not identified in the Illinois Urban Manual may also be utilized upon District approval.

At the District's discretion, an applicant may be required to submit the SESC plan to the local Soil and Water Conservation District (SWCD) or the Lake County Stormwater Management Commission (SMC) for review. When the District requires submission of an SESC plan, the following applies: An activity may not commence until the SESC plan for the project site has been approved; The SWCD/SMC will review the plan and provide a written evaluation of its adequacy; A SESC plan is considered acceptable when the SWCD/SMC has determined that it meets technical standards. Once a determination has been made, the authorized work may commence unless the SWCD/SMC has requested that they be notified prior to commencement of the approved plans. The SWCD/SMC may elect to attend pre-construction meetings with the permittee and conduct inspections during construction to determine compliance with the plans. Applicants are encouraged to begin coordinating with the appropriate SWCD/SMC office at the earliest stages of project planning. For information, contact:

Kane-DuPage SWCD
2315 Dean Street, Suite 100
St. Charles, IL 60174
(630) 584-7960 ext.3
www.kanedupageswcd.org

Lake County SMC
500 W. Winchester Rd, Suite 201
Libertyville, IL 60048
(847) 377-7700
www.lakecountyil.gov/stormwater

McHenry-Lake County SWCD
1648 South Eastwood Dr.
Woodstock, IL 60098
(815) 338-0099 ext.3
www.mchenryswcd.org

North Cook SWCD
640 Cosman Rd
Elk Grove Village, IL 60007

Will/South Cook SWCD
1201 S. Gougar Rd
New Lenox, IL 60451

(847) 885-8830
www.northcookswcd.org

(815) 462-3106
www.will-scookswcd.org

6. Total Maximum Daily Load - For projects that include a discharge of pollutant(s) to waters for which there is an approved Total Maximum Daily Load (TMDL) allocation for any parameter, the applicant must develop plans and BMPs that are consistent with the assumptions and requirements in the approved TMDL. The applicant must incorporate into their plans and BMPs any conditions applicable to their discharges necessary for consistency with the assumptions and requirements of the TMDL within any timeframes established in the TMDL. The applicant must carefully document the justifications for all BMPs and plans, and install, implement and maintain practices and BMPs that are consistent with all relevant TMDL allocations and with all relevant conditions in an implementation plan. Information regarding the TMDL program, including approved TMDL allocations, can be found at the following website: www.epa.state.il.us/water/tmdl/

7. Floodplain - Discharges of dredged or fill material into waters of the United States within the 100-year floodplain (as defined by the Federal Emergency Management Agency) resulting in permanent above-grade fills must be avoided and minimized to the maximum extent practicable. When such an above-grade fill would occur, the applicant may need to obtain approval from the Illinois Department of Natural Resources, Office of Water Resources, (IDNR-OWR) which regulates activities affecting the floodway and the local governing agency (e.g., Village or County) with jurisdiction over activities in the floodplain. Compensatory storage may be required for fill within the floodplain. Applicants are encouraged to obtain information from the IDNR-OWR and the local governing agency with jurisdiction at the earliest stages of project planning. For information on floodway construction, contact:

IDNR/OWR
2050 Stearns Road
Bartlett, IL 60103
(847) 608-3100
www.dnr.illinois.gov/WaterResources/

For information on floodplain construction, please contact the local government and/or the Federal Emergency Management Agency. Pursuant to 33 CFR 320.4(j), the District will consider the likelihood of the applicant obtaining approval for above-ground permanent fills in floodplains in determining whether to issue authorization under the RPP.

8. Navigation - Regulated activities may not cause more than a minimal adverse effect on navigation. Safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities within navigable waters of the United States. The permittee understands and agrees that if future operations by the United States require the removal, relocation, or other alteration of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work will cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim will be made against the United States on account of any such removal or alteration.

9. Proper Maintenance - Authorized structures or fill must be properly maintained, including that necessary to ensure public safety.

10. Aquatic Life Movements - Regulated activities may not substantially disrupt the movement of those species of aquatic life indigenous to the waterbody, including species that normally migrate through the area, unless the activity's primary purpose is to impound water.

11. Equipment - Soil disturbance and compaction in regulated areas must be minimized through the use of low ground pressure equipment, matting for heavy equipment, or other measures as approved by the District.

12. Wild and Scenic Rivers - Regulated activities may not occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system, while the river is in an official study status. Information on Wild and Scenic Rivers may be obtained from the appropriate land management agency in the area, such as the National Park Service and the U.S. Forest Service.

13. Tribal Rights - Regulated activities or their operation may not impair reserved Tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

14. Water Supply Intakes - Discharges of dredged or fill material may not occur in the proximity of a public water supply intake except where the discharge is for repair of the public water supply intake structures or adjacent bank stabilization.

15. Shellfish Production - Discharges of dredged or fill material may not occur in areas of concentrated shellfish production.

16. Suitable Material - Discharges of dredged or fill material may not consist of unsuitable material. Material discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act). Unsuitable material includes trash, debris, vehicle parts, asphalt, and creosote treated wood.

17. Spawning Areas - Discharges in spawning areas during spawning seasons must be avoided to the maximum extent practicable.

18. Obstruction of High Flows - Discharges must not permanently restrict or impede the passage of normal or expected high flows. All crossings must be culverted, bridged or otherwise designed to prevent the restriction of expected high water flows and designed so as not to impede low water flows or the movement of aquatic organisms.

19. Impacts From Impoundments - If the discharge creates an impoundment of water, adverse impacts on aquatic resources caused by the accelerated passage of water and/or the restriction of its flow must be avoided to the maximum extent practicable.

20. Waterfowl Breeding Areas - Discharges into breeding areas utilized by migratory waterfowl must be avoided to the maximum extent practicable.

21. Removal of Temporary Fills - Temporary fill material must be removed in its entirety and the affected area returned to pre-existing condition.

22. Mitigation - All appropriate and practicable steps must first be taken to avoid and minimize impacts to aquatic resources. For unavoidable impacts, compensatory mitigation is required to replace the loss of wetland, stream, and/or other aquatic resource functions (33 CFR 332). The proposed compensatory mitigation must utilize a watershed approach and fully consider the ecological needs of the watershed. Where an appropriate watershed plan is available, mitigation site selection should consider recommendations in the plan. The applicant must describe in detail how the mitigation site was chosen and will be developed, and be based on the specific resource need of the impacted watershed. Permit applicants are responsible for proposing an appropriate compensatory mitigation option to offset unavoidable impacts. However, the District is responsible for determining the appropriate form and amount of compensatory mitigation required when evaluating compensatory mitigation options and determining the type of mitigation that would be environmentally preferable. In making this determination, the District will assess the likelihood for ecological success and sustainability, the location of the compensation site relative to the impact site, and their significance within the watershed. Methods of providing compensatory mitigation include aquatic resource restoration, establishment, enhancement, and in certain circumstances, preservation. Compensatory mitigation will be accomplished by establishing a minimum ratio of 1.5 acres of mitigation for every 1.0 acre of impact to waters of the U.S. Furthermore, the District has the discretion to require additional mitigation to ensure that the impacts are no more than minimal. Further information is available at www.lrc.usace.army.mil/Missions/Regulatory/Illinois/Mitigation.aspx.

23. Notification - The applicant must provide written notification (i.e., a complete application) for a proposed activity to be verified under the RPP prior to commencing a proposed activity. The District's receipt of the complete application is the date when the District receives all required notification information from the applicant (see below). If the District informs the applicant within 60 calendar days that the notification is incomplete (i.e., not a complete application), the applicant must submit to the District, in writing, the requested information to be considered for review under the Regional Permit Program. A new 60 day review period will commence when the District receives the requested information. Applications that involve unauthorized activities that are completed or partially completed by the applicant are not subject to the 60-day review period. Applications may be either sent to ChicagoRequests@usace.army.mil or mailed to our office: USACE Regulatory Branch, 231 South LaSalle Street, Suite 1500, Chicago, Illinois 60604.

For all activities, notification must include:

a. A detailed narrative of the proposed activity describing all work to be performed, a clear project purpose and need statement, the Regional Permit(s) to be used for the activity, the area (in acres) of permanent and temporary fills proposed in each water of the U.S., and a statement that the terms and conditions of the RPP will be followed. For projects with impacts to multiple aquatic resources, provide a table identifying impact types and amounts.

b. A completed joint application form for Illinois signed by the applicant or agent. The application form is available at www.lrc.usace.army.mil/Portals/36/docs/regulatory/forms/appform.pdf. If the applicant does not sign the joint application form, notification must include a signed, written statement from the applicant designating the agent as their representative.

c. A delineation of waters of the U.S., including wetlands, for the project area, and for areas adjacent to the project site (off-site wetlands must be identified through the use of reference materials including review of local wetland inventories, soil surveys, and the most recent available aerial photography), must be prepared in accordance with the current U.S. Army Corps of Engineers methodology (www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/reg_supp.aspx) and generally conducted during the growing season.* The District's wetland delineation standards are available at www.lrc.usace.army.mil/Portals/36/docs/regulatory/pdf/Delineations.pdf. For sites supporting wetlands, the delineation must include a Floristic Quality Assessment (Swink and Wilhelm. 1994, latest edition, Plants of the Chicago Region). The delineation must also include information on the occurrence of any high-quality aquatic resources (see Appendix A), and a listing of waterfowl, reptile and amphibian species observed while at the project area. The District reserves the right to exercise judgment when reviewing submitted wetland delineations. Flexibility of these requirements may be allowed by the District on a case-by-case basis only.

d. A street map showing the location of the project area.

e. Latitude and longitude for the project in decimal degrees format (for example 41.878639N, -87.631212W).

f. Preliminary engineering drawings sized 11" by 17" (full-sized may be requested by the project manager) showing all aspects of the proposed activity and the location of waters of the U.S. to be impacted and not impacted. The plans must include grading contours, proposed and existing structures such as buildings footprints, roadways, road crossings, stormwater management facilities, utilities, construction access areas and details of water conveyance structures. The plans must also depict buffer areas, outlots or open space designations, best management practices, deed restricted areas and restoration areas, if required under the specific RP.

g. Submittal of soil erosion and sediment control (SESC) plans that identify all SESC measures to be utilized during construction of the project.

h. A determination whether resources (species, their suitable habitats, or critical habitat) listed or designated under the Endangered Species Act of 1973, as amended, may be present within areas affected (directly or indirectly) by the proposed project. Applicants must provide a section 7 species list for the action area using the on-line process at the USFWS website. You can access "U.S. Fish and Wildlife Service Endangered Species Program of the Upper Midwest" website at www.fws.gov/midwest/Endangered. Click on the section 7 Technical Assistance green shaded box in the lower right portion of the screen and follow the instructions to completion. Review all documentation pertaining to the species list and provide your effects determination for each species along with the rationale for your effects determination for each species to this office for review.

   In the event there are no species, their suitable habitats, or critical habitats within areas affected (directly or indirectly) by the proposed project, then a "no effect" determination can be made and section 7 consultation is not warranted. If species or critical habitat appear on the list, or suitable habitat is present within the action area, then a biological assessment or biological evaluation will need to be completed to determine if the proposed action will have a "no effect" or a "may affect" determination on the species or suitable habitat. The District will request initiation of section 7 consultation with the USFWS upon agreement with the applicant on the effects determinations in the biological assessment or biological evaluation. If the issues are not resolved, the analysis of the situation is complicated, or impacts to listed species or critical habitat are found to be greater than minimal, the District will consider reviewing the project under the Individual Permit process.

i. A determination of the presence or absence of any State threatened or endangered species. Please contact the Illinois Department of Natural Resources (IDNR) to determine if any State threatened and endangered species could be in the project area. You can access the IDNR's Ecological Compliance Assessment Tool (EcoCAT) at the following website: dnr.illinois.gov/EcoPublic/. For the first general information question, select "To obtain information on Illinois T&E species or INAI sites for federal agency actions" and select "U.S. Army Corps of Engineers" from the drop down

* If a wetland delineation is conducted outside of the growing season, the District will determine on a case-by-case basis whether sufficient evidence is available to make an accurate determination. If the District finds that the delineation lacks sufficient evidence, the application will not be considered complete until the information is provided. This may involve re-delineating the project site during the growing season.

menu. Once the EcoCAT and consultation process is complete, forward all resulting information to this office for consideration. The report must also include recommended methods as required by the IDNR for minimizing potential adverse effects of the project.

j. A statement about the knowledge of the presence or absence of historic properties, which includes properties listed, or properties eligible to be listed in the National Register of Historic Places. The permittee must provide all pertinent correspondence documenting compliance. Initial documentation required for the Illinois State Historic Preservation Officer (ILSHPO) is located here: https://www2.illinois.gov/dnrhistoric/preserve/pages/resource-protection.aspx. The Historic and Architectural Resources Geographic Information System (HARGIS) at http://gis.hpa.state.il.us/hargis/ is the public portal to Illinois' historic buildings, structures, sites, objects, and districts. This database contains properties that have been listed in the National Register of Historic Places, determined eligible for listing, or surveyed without a determination.

k. Where an appropriate watershed plan is available, the applicant must address in writing how the proposed activity is aligned with the relevant water quality, hydrologic, and aquatic resource protection recommendations in the watershed plan. A list of watershed plans is available at www.lrc.usace.army.mil/Missions/Regulatory/Illinois/WatershedPlans.aspx.

l. A discussion of measures taken to avoid and/or minimize impacts to aquatic resources on the project site.

m. A compensatory mitigation plan for all impacts to waters of the U.S. (if compensatory mitigation is required under the specific RP) in compliance with 33 CFR 332.

n. A written narrative individually addressing each of the items listed under the specific RP(s) being requested.

For Category II activities, the District will provide an Agency Request for Comments (ARC) which describes the proposed activity. The ARC will be sent to interested Federal, state and local agencies, and appropriate Indian Tribes for review and comment. Additional entities may also be notified as needed. Agencies have ten (10) calendar days from the date of the ARC to contact the District and either provide comments or request an extension, not to exceed fifteen (15) calendar days. The Illinois Historic Preservation Agency and Indian Tribes have thirty (30) calendar days from the date of the ARC to provide comments. The District will fully consider agency comments received within the specified time frame. If the District determines that the activity complies with the terms and conditions of the RPP and impacts on aquatic resources are minimal, the District will notify the applicant in writing and include special conditions if deemed necessary. If the District determines the impacts of the proposed activity are more than minimal, the District will notify the applicant that the project does not qualify for authorization under the RPP and instruct the applicant on the procedures to seek authorization under an Individual Permit.

24. Compliance Certification - Any permittee who has received authorization under the RPP from the District must submit a signed certification stating that the authorized work has been completed. The certification will be forwarded by the District with the authorization letter and will include: a) a statement that the authorized work was done in accordance with the District's authorization, including any general or specific conditions; b) a statement that any required mitigation was completed in accordance with the permit conditions, and; c) the signature of the permittee certifying the completion of the work and mitigation.

25. Multiple use of Regional Permits - In any case where a Regional Permit is combined with any other Regional Permit to cover a single and complete project (except where prohibited under specific Regional Permits), the applicant must notify the District in accordance with General Condition 23. If multiple Regional Permits are used, the total impact may not exceed the maximum allowed by the Regional Permit with the greatest impact threshold.

26. Other Restrictions - Authorization under the RPP does not obviate the need to obtain other Federal, State or local permits, approvals, or authorizations required by law nor does it grant any property rights or exclusive privileges, authorize any injury to the property or rights of others or authorize interference with any existing or proposed Federal project.

Approved by:

//ORIGINAL SIGNED/ March 23, 2017

Christopher T. Drew
Colonel, U.S. Army
District Commander

Date

# REVISIONS TO THE ILLINOIS PREVAILING WAGE RATES

The Prevailing rates of wages are included in the Contract proposals which are subject to Check Sheet #5 of the Supplemental Specifications and Recurring Special Provisions. The rates have been ascertained and certified by the Illinois Department of Labor for the locality in which the work is to be performed and for each craft or type of work or mechanic needed to execute the work of the Contract. As required by Prevailing Wage Act (820 ILCS 130/0.01, et seq.) and Check Sheet #5 of the Contract, not less than the rates of wages ascertained by the Illinois Department of Labor and as revised during the performance of a Contract shall be paid to all laborers, workers and mechanics performing work under the Contract. Post the scale of wages in a prominent and easily accessible place at the site of work.

If the Illinois Department of Labor revises the prevailing rates of wages to be paid as listed in the specification of rates, the contractor shall post the revised rates of wages and shall pay not less than the revised rates of wages. Current wage rate information shall be obtained by visiting the Illinois Department of Labor web site at http://www.state.il.us/agency/idol/ or by calling 312-793-2814. It is the responsibility of the contractor to review the rates applicable to the work of the contract at regular intervals in order to insure the timely payment of current rates. Provision of this information to the contractor by means of the Illinois Department of Labor web site satisfies the notification of revisions by the Department to the contractor pursuant to the Act, and the contractor agrees that no additional notice is required. The contractor shall notify each of its subcontractors of the revised rates of wages.